TYFLO MATHEMATIC
TRAVEL GUIDE AROUND POLAND

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The participants of the project were pupils from grades seven and eight of Primary School No. 2 at the Special School and Education Center for Blind Children in Owińska, under the supervision of mathematics teachers:
Magdalena Ciesielska and Maria Kaliszan-Kaźmierczak.

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Project Coordination,
adaptation of Braille version: **Maria Kaliszan-Kaźmierczak**

Contents, maps
graphic editorial
cover design: **Magdalena Ciesielska**

Text editor: **Piotr Kaźmierczak**

English translation: **Maja Włodarczyk**

Graphics of portraits
Mathematicians
in the relief version: **Kacper Kaczmarek**

students participating
in the project: **Amelia Belter**

Szymon Kipar

Borys Kozielewicz

Julia Kożuszek

Natasza Rybarczyk

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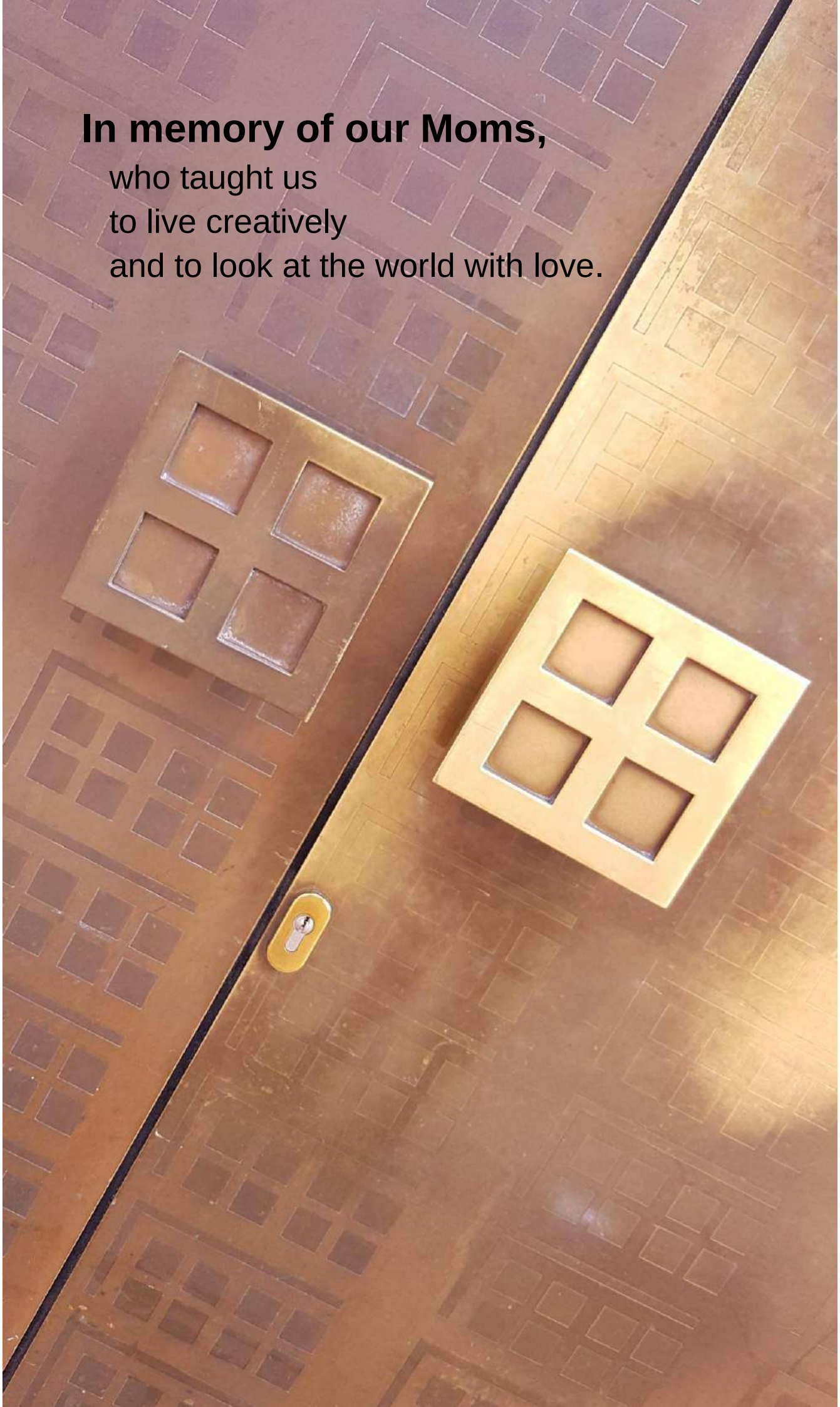

In memory of our Moms,

who taught us
to live creatively
and to look at the world with love.

The map of Poland with routers

Drawing by Magdalena Ciesielska

based on a map from the typhlological Atlas of Polish
(Main Office of Geodesy and Cartography, Main Board of PZN)

Spis treści:

Route No. IV Figures known and unknown

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The "Sons of the Pulk" Special School for the Blind Children in Owińska and Spatial Orientation Park

Photo from the collection of the District Office of Poznan

Makieta przed Ośrodkiem, Owińska, Plac Przemysława 9

Fot. Amelia Belter, zbiory własne

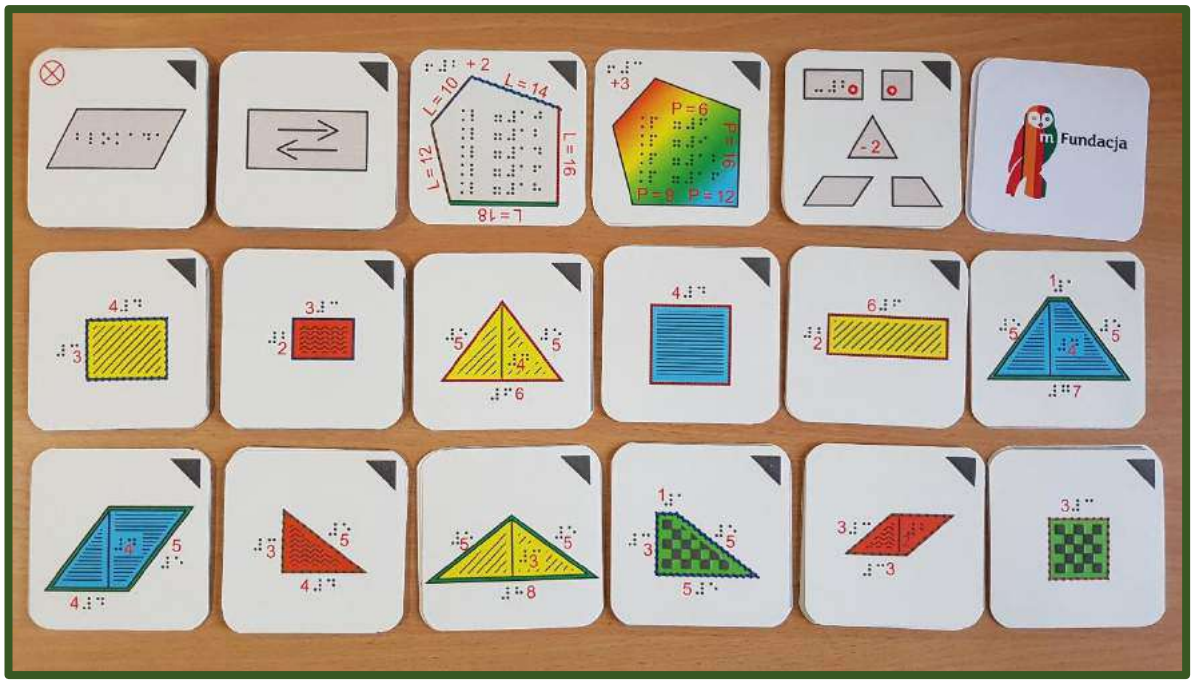
Introduction

“Mathematics is the alphabet by which God described the universe”, Galileo believed. We are surrounded by geometric figures, solids, arcs and lines that can be described by formulas. Mathematics is everywhere, although we don't always notice it immediately. In this guide we want to show objects inspired by mathematics, places dedicated to eminent Polish mathematicians and interesting places for learning and playing.

This is the first guide in Poland which points out to mathematics enthusiasts and amateurs places worth visiting, connected with their interests and passion. It is also the author's guide. In it, we present those sites that have made the greatest impression on us and that can be, in our opinion, the most inspiring.

The idea for the guide came from the Special School and Education Centre for Blind Children in Owińska. It was the teachers and students from Owińska that searched for and described the places to be included in the guidebook. It is here that games for the blind and visually impaired were created, such as "Figurki", "BingoBrajl" and the Multisensory Mathematical Calendar "365 Days with the Queen of Sciences". It is also home to the Museum of Typhlology with a rich collection of teaching aids for the blind, e.g. cubarithms for mathematican operations. A great attraction of the Center is the Spatial Orientation Park modeled on a baroque garden full of fragrance, geometry and symmetry.

Games: Figures, BingoBrajl and Mathematical Calendar



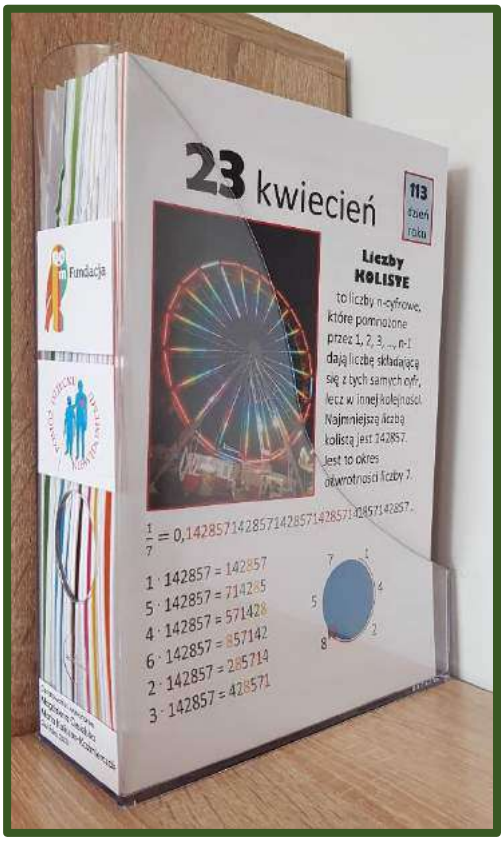


Photo: Magdalena Ciesielska – private collection.

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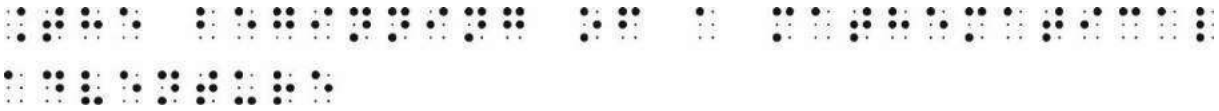
ROUTE NO. I

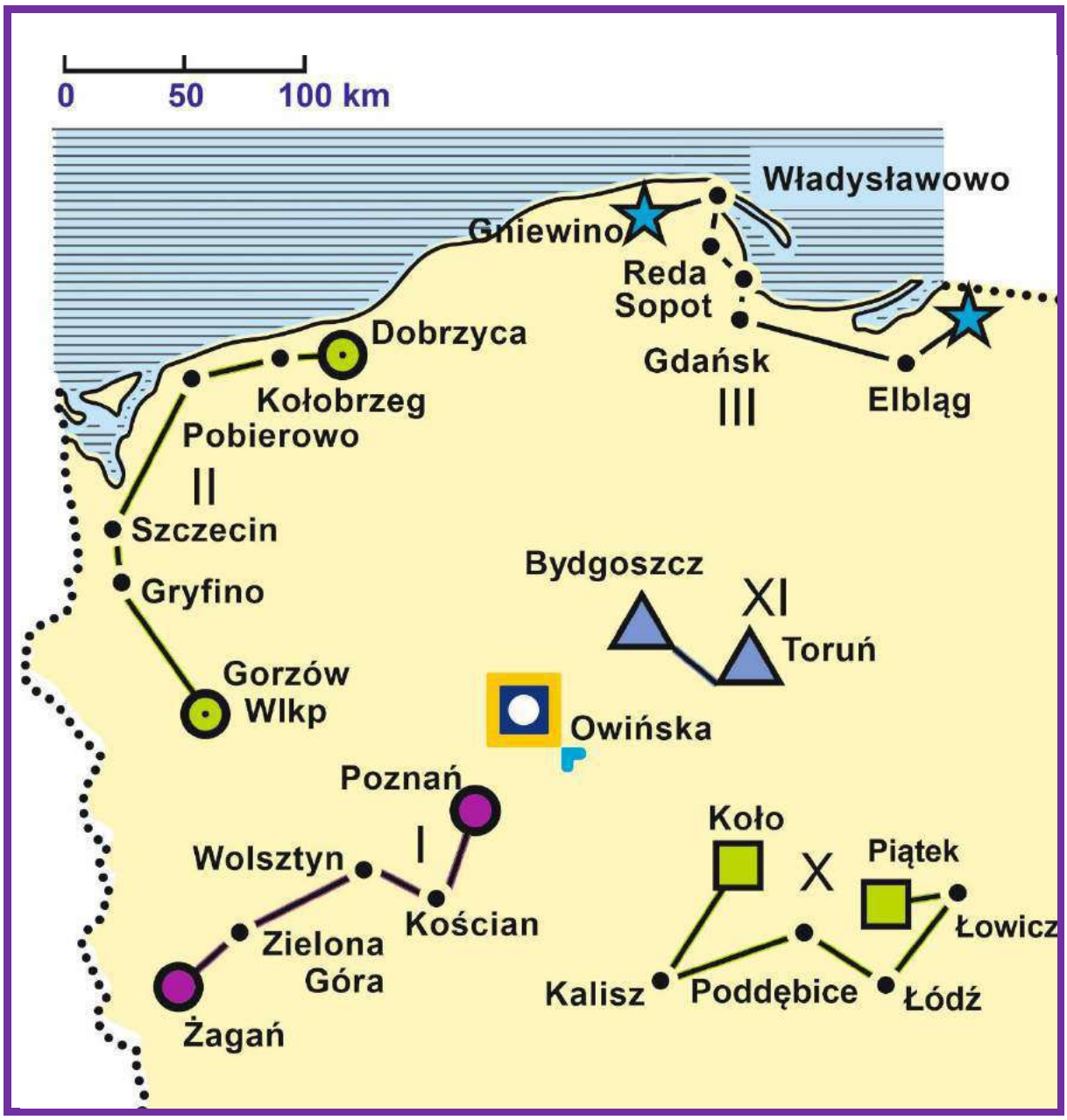
The beginning of a mathematical adventure



The route includes part of the Wielkopolskie and Lubuskie voivodships:

- **Poznan**
- **Koscian**
- **Wolsztyn**
- **Zielona Gora**
- **Zagan**

The map of north-west Poland



Picture: Magdalena Ciesielska

based on a map from the typhlological Atlas of Poland
(Main Office of Geodesy and Cartography, PZN Board)

1. Founder of the Poznan school of Mathematics

He studied at the Technical University of Lvov, at that time a Polish city that fostered the talent of outstanding scientists. Władyslaw Orlicz had the opportunity to attend lectures by such mathematicians as Stefan Banach and Hugo Steinhaus. He left Lvov in 1945 when the Second World War was followed by forced deportations of Poles from the eastern borderlands, and moved to Poznan. He was a professor at the University of Poznan, president of the Polish Mathematical Society and founder of the Poznan school of Mathematics.
At 22 Libelta Street there are the so-called professors' houses - buildings specially designed for university scientists with reinforced ceilings for bookshelves. Wladyslaw Orlicz lived at number 4. On the wall of the building there is a memorial board with the names of the professors who lived there.
Wladyslaw Orlicz was buried on 17 August 1990 in the Alley of the Deserved in the Junikowo Cemetery in Poznan.

Professors' Houses, Poznan, 22 Libelta Street

Photo: poznan.pl, Mateusz Malinowski

2. The encrypted museum

They were great mathematicians, able to translate their skills into solving a specific task. They broke a cipher which seemed to be maximally secured and impossible to read. Marian Rejewski, Jerzy Rozycki and Henryk Zygalski contributed to a quicker end of World War II. A museum devoted to the breaking of the Enigma code and to the people who managed to do it has been established in Poznan. This unique exhibition, which combines the world of mystery, knowledge and science, is located in Collegium Martineum of Adam Mickiewicz University, where a branch of the Cipher Bureau of the General Staff of the Polish Army was located before World War II.

Enigma Cipher Centre, Poznan, 78 Święty Marcin Street

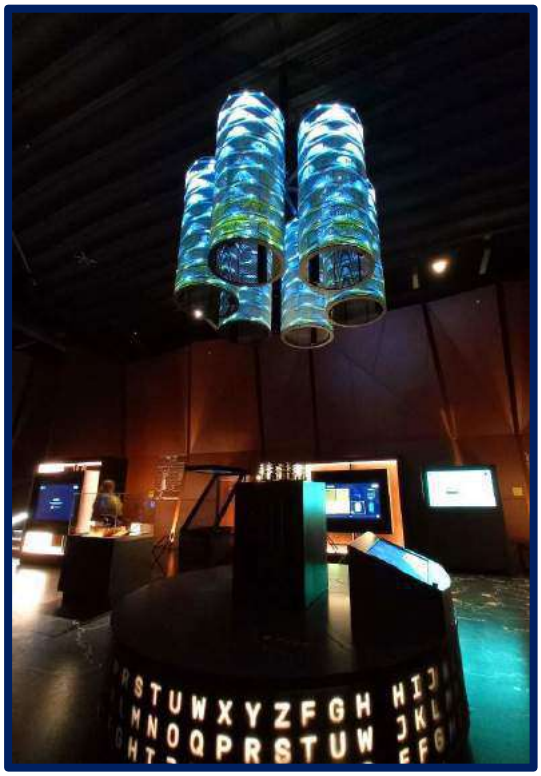


Photo: Beata Ciesielska, private collection

Near the Museum, there is a cryptologists' monument in the form of a metal prism with a triangular base. Each of the sides of the block is covered with numbers, among which are the names of three Poles who achieved the impossible.
In the hall of the Collegium Minus of the Adam Mickiewicz University there is a board honoring the three cryptologists.

Cryptologists’ Monument, Poznan, Square in front of the Imperial Castle, 80 Święty Marcin Street

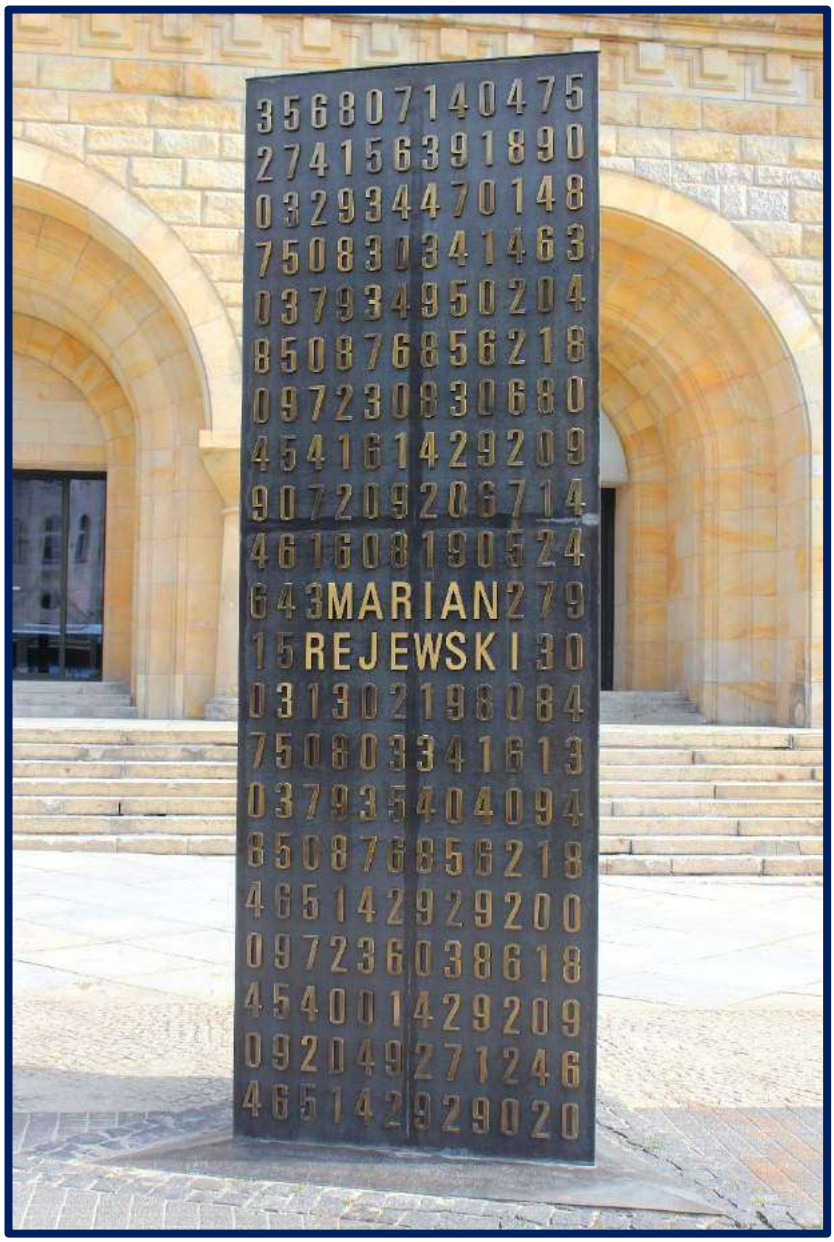


Photo: Wikipedia.pl, Pnapora

3. The other side of the square

In Poznań during your trip it is worth taking a rest in Stary Browar. Here you can find not only cafes and restaurants, but also a park with a playground inspired by mathematics. Balls and cubes, as well as the possibility to cross the square are just a few of the attractions of this place. After the fun is over, enjoy an ice cream from the Lodovnia, which is lined with cone-shaped spikes.

“Stary Browar” Gallery, Poznan, Półwiejska Street 38

Photo: Magdalena Ciesielska – private collection.

Fun fact: A square on the banknote is an indicator for the blind of its denomination - PLN 10.

4. Rocket over Poznan

The spire at the Poznań Fair was supposed to be a glass cylinder, but it ended up as a rocket taking off into space. When it was built in 1955, its openwork structure towered over the city, and although many taller buildings have been built since then, this 64-meter spire on the Fair grounds is one of the city's flagships. For several years, in December, the Spire became a Christmas tree, thanks to the green illumination of the structure and hanging luminous chain measuring nearly 500 meters.

Poznan International Fair, 14 Głogowska Street

Photo: Wikimedia.pl, collection of Poznan International Fair

5. Avalanche of Cubes

Avalanche in the mountains is an unstoppable force, which can not resist anything. The avalanche which is created by the building located at 22 Roosevelt Street is a phenomenal combination of cubic blocks forming a unique building, which seems to be pouring out on the city. The 16-storey high building when viewed from different sides makes an incredible impression.

Business Centre „Bałtyk”,
Poznan 22 Franklin Roosevelt Street

Photo: Wikipedia.pl, Four.mg, MOs810

6. Mathematics and Biology

The simple shape of the cuboid with rounded corners would not make much of an impression if it were not for the façade of this building. From a distance, thanks to the right choice of colors and materials, it looks like a rhombic tower hovering over the city. Worth seeing up closer is the symmetry of the building and geometric figures, used to give it a unique character. Interestingly, the mathematical effect of this building was not at the core of its architectural concept. The façade of Nobel Tower was inspired by an arrangement of muscular tissue, which is supposed to reflect the medical and technological activities conducted in the building.

„Nobel Tower" Office Buildung, Poznan, 77a Poznanska Street

Photo: Wikipedia.pl, Four.mg

Fun fact: The rhombus on the 50 zloty banknote makes it easier for the blind to recognise it.

7.Chess Board made of pixels

By definition, a pixel is the smallest solid image element displayed on digital devices. The pixel office building in Poznań is an example of how architecture can use the simplest geometric forms to achieve spectacular effect. The facade of the building from Grunwaldzka Street is calm, almost completely glazed. On the other hand, from the inside, architects designed a body consisting of protruding cubes that resembles a three-dimensional chessboard. The space between them was filled with wood and greenery.

„Pixel” Office Building, Poznan, 182 Grunwaldzka Street

Photo: Wikimedia.pl, Juliusz Sokołowski

Fun fact:

A chessboard has 64 fields. The same number of combinations can be made on a Braille hexapoint.

8. Triangles to Heaven

The observation tower in Poznan's Szachty district is 25 meters high. Light structure of the prism with a triangle base is impressive. It is worth climbing 120 steps to admire the surrounding ponds, wild nature and different species of birds, from the observation deck. Parking for cars near the observation tower in Poznań's Szachty is located at Witaszka Street or at Kocha street.

Observation tower in Szachty, Poznan, Stara Cegielnia 1

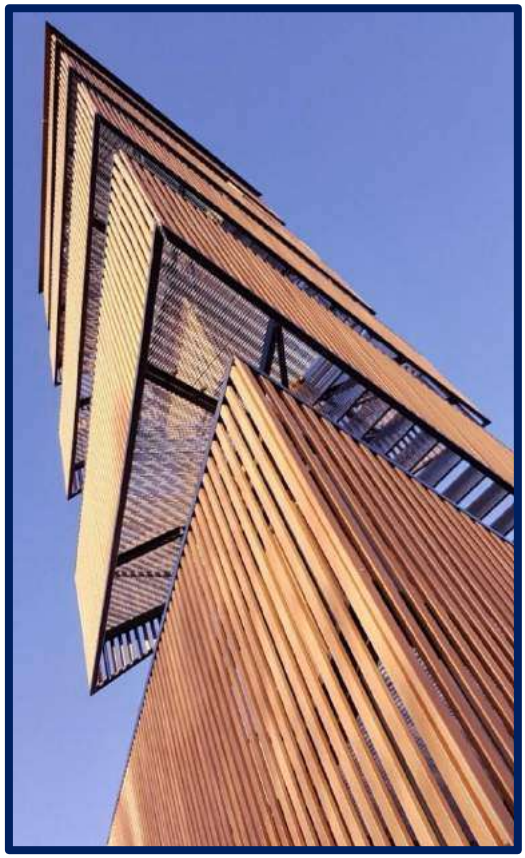


Photo: Magdalena Ciesielska – private collection.

Fun fact: The triangle on the banknote is an indicator fot the blind of its denomination - PLN 200.

9. How to become a ray?

The "Nenufar Club" is a unique amusement park. In such places mathematics is discovered while having fun. Getting out of the kayak you can see the model of an Egyptian pyramid up close, and in the laser maze you can observe how oblique straits look like. You can also check what it is like to be the radius of a circle, shoot with a bow or play laser paintball. A trip to Kościan is an excellent idea for the youngest to spend an entertaining time, and at the same time discover a few secrets of the queen of sciences.

Nenufar Club, Koscian, 21 Boczna Street

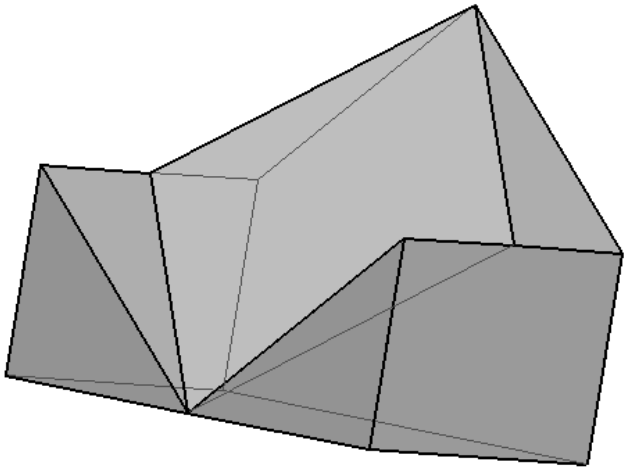
Photo: M. P. Ciesielscy, private collection.

Fun fact: The circle on the banknote is an indicator for the blind of its denomination - 20 PLN.

10. One upon the time there was a solid

Someone invented the use of a wheel, someone invented a light bulb, and Janusz Kapusta invented a solid. The K-drone he designed, was patented in the USA on May 29, 1985 by the United States Patent office at number 4681481 and to date is used by engineers to design building facades, roof tiles, ceilings, furniture, toys, games and even jewelry. This is one of the few inventions that got their sculptures.
How Janusz Kapusta notices in two inscribed squares spatial form, will remain his secret. But in 1985, he made a paper model of a solid he called a K-drone. The name comes from the Greek language. The drone in this language means a wall, "K" is the 11th letter of this alphabet. The K-drone consists of a surface that is a rhombus with attached right triangles and a base K-drone, forming a total of an elevahedron. The most interesting characteristic of the K-drone is the fact that two K-drones put together add up to a cube.

K-drone model



Wikipedia.pl

11. Banachusik

Mathematics requires both imagination and discipline. Creating a Banachusik modeled on the outstanding Polish mathematician Stefan Banach required imagination and a sense of humor. The statue can be seen at the entrance to the building of the Faculty of Mathematics, Informatics and Econometrics of the University of Zielona Gora in Szafrana Street. Banachusik are the cheerful spirits of Zielona Góra, and their silhouettes can be seen in almost every corner of the city. This one, presenting a silhouette of a mathematician, was the 48th figurine to be installed in the streets of the city. The biretta-clad Banachusik is sitting on a book, whose title is "Studia Mathematica" - the same as the name of the journal devoted functional analysis that Banach and Hugo Steinhaus created in Lviv in 1929.

„Banachusik”, University of Zielona Gora, Szafrana Street

Photo: Piotr Frąszczak

12. Explorer of the stars

Mathematician, astronomer and author of the world's first science fiction novel, for several years lived and worked in Żagań. In this city, where he probably lived, there is a street named after him, a monument and the Kepler restaurant, whose walls are decorated with paintings referring to his works. Today in the era of narrow specialization Kepler's achievements are very impressive.
The list of his achievements is long. As a mathematician, he introduced the comma to write decimal fractions. He made the description of stellar polyhedra. He also developed methods for calculating the volume of rotating solids, which he described in his work "New stereometry of wine barrels”.

Portrait of Johannes Kepler

Photo: Wikimedia.pl, public property

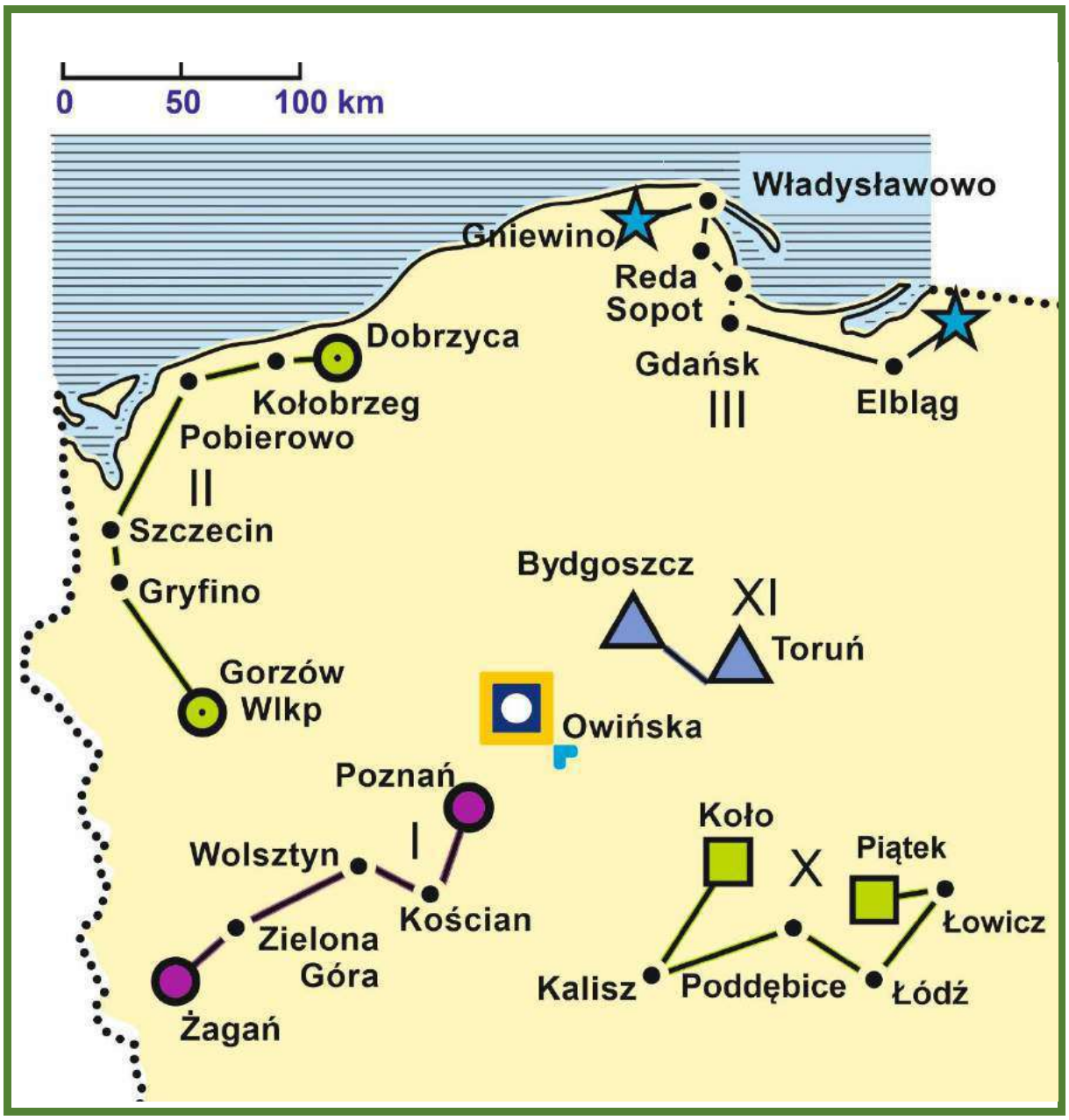
ROUTE NO. II

Can geometry be a curve?

The route covers the West Pomeranian Voivodeship and part of Lubuskie Voivodeship:

- **Gorzow Wielkopolski**
- **Gryfino**
- **Szczecin**
- **Pobierowo**
- **Kołobrzeg**
- **Dobrzyca**

The map of northwest Poland



Drawing by Magdalena Ciesielska

based on a map from the typhlological Atlas of Polish
(Main Office of Geodesy and Cartography, Main Board of PZN)

13. The aliens land in Gorzow

The amazing structure of the observation tower in Gorzow makes a great impression, if not greater than the landscape stretching out from it. By the inhabitants, it is called “Spider” because of its unusual structure whose 18 bent supports rise to a height of 20 meters. Its shape resembles an object from another galaxy which landed in the center of the capital of the Lubuskie Voivodeship. The object is quite controversial, but out of the point the view of a math lover is extremely curious. The name "Dominant" itself, taken from statistics, directs us towards the queen of sciences. Curves, cylinder, sphere, shaped spiral staircase helicoids are a brief description of what the tower looks like.

"Dominant" observation tower,
Gorzow Wielkopolski, roundabout Saint George

Photo: Wikipedia.pl, Staszek99

14. Crooked Forest

In a normal forest, a math teacher can bring students closer, at most, to the concept of a straight line or segment. In Crooked Forest near the town of New Czarnowowo near Gryfino, he can find an example of curves. There are trees bent arched underneath an angle of approx. 90 ° from approx. 20 cm above the ground, curvature in some reaches a height of 3 m.
The best known theory is that the trees were shaped as a result of deliberate activity of people who cultivated them specially for the so-called cams for purposes of carpentry or boatbuilding such as furniture, boat and sleigh construction.

Krzywy Las, Nowe Czarnowo near Gryfino

Photo: Magdalena Ciesielska, private collection

Photo: Magdalena Ciesielska, private collection

15. Geometry rules at the philharmonic hall

Music theorists have no doubt that in some works Bach, Mozart and Beethoven used geometric solutions. The building of the Mieczysław Karłowicz Philharmonic in Szczecin is a tribute to geometry and the city. Building form refers to the landscape of Szczecin and the surrounding plot, where houses and churches have multi-hipped roofs. The method of constructing the facade is pure geometry. Soaring constructions of triangles aiming at the sky, form an amazing impression of geometric solids hovering over your head.

Mieczysław Karłowicz Philharmonic,
Szczecin, 48 Malopolska Street

Photo: Wikipedia.pl, drKssn

Mieczysław Karłowicz Philharmonic, Szczecin, 48 Malopolska Street

Photo: Wikipedia.pl, Kapitel

16. Mathematicians in Pobierowo

If you come to this charming seaside town in the spring, it is possible that you will meet passers-by - enthusiasts of the Queen of science. Every year, a Mathematics teachers' Scientific Conference “Mathematics - our invisible culture”, organized by the University of Szczecin, is held here, along with an International Photo Contest "Mathematics in Objective".

"Isn't math beautiful?”

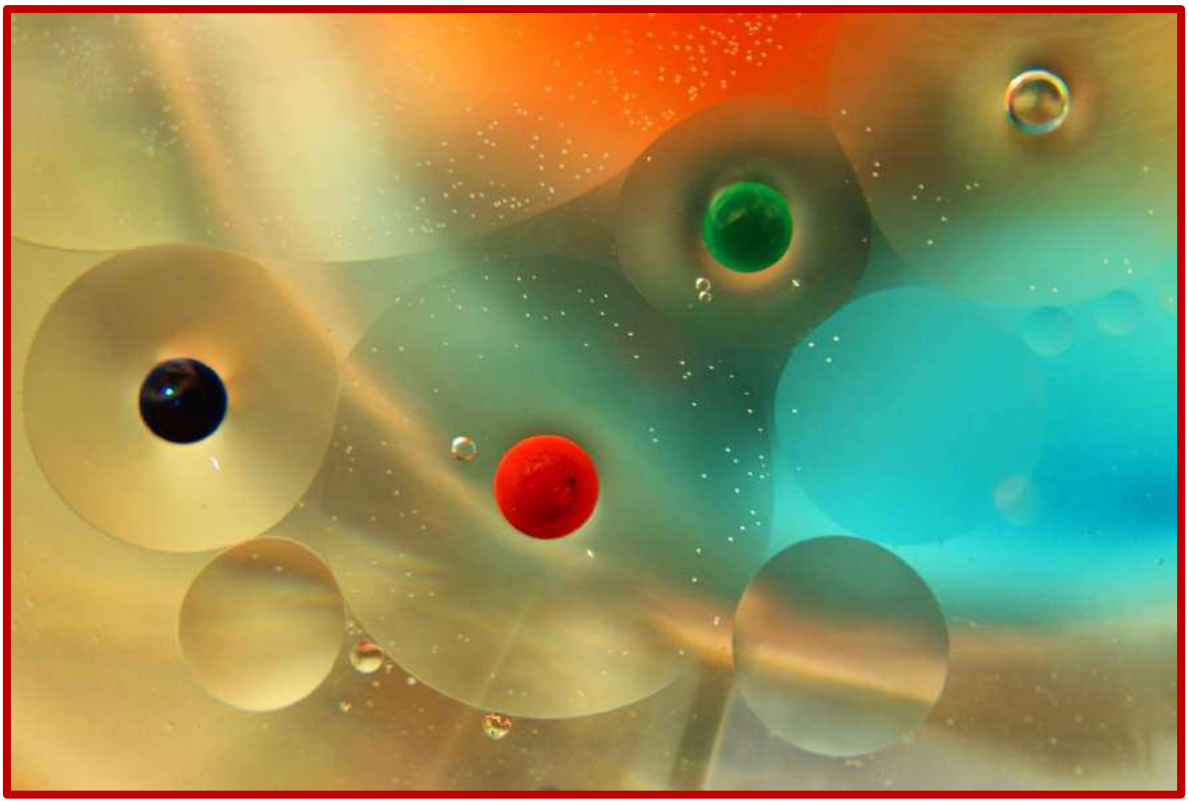


Photo Magdalena Ciesielska - 3rd place winner (2013)

When visiting Pobierowo, be sure to see the flower clock, and especially the square on which it is situated. It consists of numerous circles of different diameter and symmetrical arcs.

Photo Magdalena Ciesielska, private collection

When walking on the beach in winter, you may be able to meet "morocco", that is the ice balls floating by the shore and thrown onto the sand. However, it is a very rare phenomenon on the Baltic Sea. But you can always walk on the ceiling of the Magic House repeating powers with a negative exponent.

"Magic House", Pobierowo, 35 Grunwaldzka Street

Photo Wikipedia, Aw58

17. Anti-erosion geometry

Huge concrete blocks, as being built on the tetrahedron's plan, are called star blocks. They consist of four truncated cones. These nearly five-ton structures are used to prevent erosion of the coastline. They were invented and patented in 1950. On the Polish coastone of their largest clusters is located in Kołobrzeg. In Darłowo, the star block was used as a monument commemorating the hurricane of Xawery, which raged over the city in December 2013. This mighty concrete cast was thrown on shore, exactly where it was decided, to be left as a symbol of power, but also as a warning to those who try to play with it.

Star blocks in Kołobrzeg

Photo Wikipedia.pl, Radosław Doożdżewski

18. Symmetry all in flowers

The Hortulus theme gardens are one of the greatest attractions in West Pomeranian Voivodeship. Among trees and shrubs and thousands of varieties of flowers, queen of science lovers will also find something for themselves. In Dobrzyca you can visit themed gardens inspired by cultures from all over the world. You can also see the ones that have been inspired by math. Geometric gardens are characterized by high order and symmetry. Many geometric, such as diamonds, circles, triangles, squares formed of shrubs appear there, but also wonderfully fragrant flowers. Learning about symmetry and geometry in a place like this is such a pleasure.

Hortulus Theme Gardens, Dobrzyca 76

Photo Wikipedia.pl,

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ROUTE NO. III

Coastal geometry

The route covers the Pomeranian Voivodeship and part of the Warmian-Masurian Voivodeship:

- **Gniewino**
- **Władysławowo**
- **Reda**
- **Sopot**
- **Gdańsk**
- **Raczki Elbląskie**
- **Elbląg**
- **Frombork**

The map of north Poland

Drawing by Magdalena Ciesielska

based on a map from the typhlological Atlas of Polish
(Main Office of Geodesy and Cartography, Main Board of PZN)

19. Observation tower looking like a Sauron’s eye

Kashubian Eye in Gniewino is worth a visit because of the attractions it offers. Playgrounds for children, mini-golf course, rope park and dinosaur models. Lovers of mathematical attractions will be especially interested in the observation tower, which looks as if it was inspired by the tower with the eye of Sauron from the film "Lord of the Rings".
The tower soars 44 metres above the surrounding area. The openwork outer structure gives it the shape of a sleek hyperboloid, while the inner cylinder is surrounded by a spiral staircase, creating a mathematical figure called a helicoid. At its top is a circular observation tower. It can be reached by stairs or a lift.

Kaszubskie Oko observation tower,
Gniewino, 5 Sportowa Street

Photo: Wikipedia.pl, Jarl

20. Church made of triangles

For a mathematician, the Church of the Assumption of the Blessed Virgin Mary in Władysławowo is a phenomenal combination of triangular prisms, triangular windows and stained-glass windows of this shape. A skeleton made of reinforced concrete supports a large pitched roof, which on both sides is decorated with triangular stained-glass windows stretched like the sails in the wind.
The stained-glass windows in this church are considered to be among the most interesting in the world, and the tourist value of the site is enhanced by the bell tower next to the church, which also serves as an observation tower.

Catholic church of the Assumption of the Blessed Virgin Mary, Władysławowo, 32 Żeromskiego Street

Photo: Wikipedia.pl, Wojtek Bzdyk

Fun fact: The triangle on the banknote is an indication for the blind of its nominal value - 200 PLN.

21. Eye to eye with sharks

There are definitely people who would prefer an encounter with a shark than with a strict maths teacher. And certainly they would prefer an encounter with this marine predator in Aquapark Reda, which is one of the biggest attractions of the Pomeranian Voivodeship.
This place is a perfect stop while searching for mathematical inspirations in architecture and art, although you can also find them here. First, we jump into the mouth of a shark, after which we have to go down an illuminated 60-metre slide. The only thing separating us from the sharks swimming around is a transparent cylinder-shaped surface. Luckily it looks solid, because the predators from Sri Lanka look really dangerous.

Aquapark Reda, Reda, Morska 5 Street

Photo: Aquapark Reda, private collection.

22. Crooked house in Sopot

The crooked house standing on Monciak in Sopot looks like the fantasy of a mad mathematician who does not recognise straight lines. It borders on a miracle that all the curves used in this unusual construction form a functional building. It forms part of the "Rezydent" Shopping Centre. So you can eat well here and buy some souvenirs.
In the list of 50 strangest buildings in the world published by the Village of Joy portal, the Crooked House in Sopot took first place.

Crooked House,
Sopot, 53 Bohaterów Monte Cassino Street

Photo: Wikipedia.pl, Topory

23. Memory written in a block

The imposing prism tilting dangerously over the surrounding terrain brings to mind a collapsing building to some, while others associate it with a bayonet drawn to defend themselves. The simple geometric mass of the building leaves no one unconcerned.
The Museum of the Second World War in Gdańsk is the largest historical museum in Poland, its main exhibition covers an area of almost 5 000 m2, and is located 14 metres underground. The exhibition hall on cryptology is particularly worth seeing.

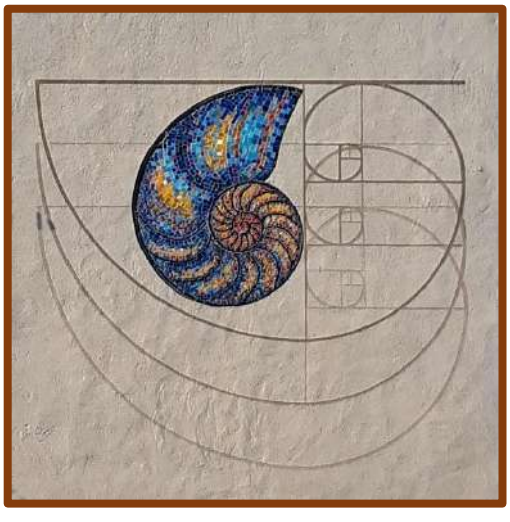
Museum of the Second World War,
Gdańsk, Władysław Bartoszewski Square 1

Photo: Wikipedia.pl, Jroepstorff

24. Fibonacci spiral

Sometimes it is worth looking up, because what is worth seeing is not always at the height of our sight. A beautiful stamp on the Gdańsk tenement house at 29 Szeroka Street is a mosaic in the form of a colourful shell complemented with a painting spiral based on Fibonacci numbers.
The Fibonacci sequence is used in architecture and its proportions were used to build the Greek Parthenon. In painting, it was used by Leonardo da Vinci in the creation of the Mona Lisa, and by Salvador Dali in "The Sacrament of the Last Supper". The Italian mathematician's formula was also widely used by musicians and writers.

Gdańsk, 29 Szeroka Street



Photos: Anonymous author

25. Mathematical Brainteasers

In the Hevelianum Centre, located on the site of the former Gradowa Hill fort, history meets the future. Students of all ages can learn the secrets of engineering, chemistry, physics, nature and also mathematics. The queen of sciences rules in a place named Łamigłówka. Thanks to a unique artistic design, visitors crossing the threshold of the mathematical exhibition immediately enter the world of geometry, symmetry and numbers. However, the mathematical scenery is only a background for interactive learning and fun.
In the experimental space you can, for example, discover a surface that has only one side or see if a metre is the same distance for everyone. There are also "twisted figures", i.e. rotation solids, tangrams or the well-known Pythagorean theorem.

Hevelianum Center, Gdańsk, 6 Gradowa Street

Photo: Centrum Hevelianum, private collection

26. Gate to the Republic of Poland

The Wisłoujście Fortress, known as the gate to the Republic of Poland, is one of the most noteworthy fortification monuments. Historians will appreciate its significance for the defence of our country, and lovers of mathematics will appreciate its symmetry and the use of geometry.
The central and at the same time the oldest point of the fortress is the cylinder-shaped tower, which was a lighthouse until the middle of the 18th century. It rises to a height of 22 metres, and on its top there is an observation deck. It is worth the effort to climb it and admire the unusual symmetry that prevails in this place from a height.

Wisłoujście Fortress, Gdańsk, Old Fortress 1

Photo: Wikipedia.pl, Jakub Strzelczyk

-1,8 27. Less than zero

Nobody likes being under the line. A negative balance is not pleasant for anyone. For many students negative numbers are also a problem. However, there is a place in Poland where you can find out that it is nothing terrible. The depression in Raczki Elbląskie is located 1.8 metres below sea level. This lowest point in Poland on the numerical axis would be the equivalent of a negative number. From the point of view of tourism, it is one of the most interesting places in our country. It is more than two and a half kilometres from the highest peak, Rysy.

Raczki Elbląskie

Photo: Magdalena Ciesielska, private collection

28. Geometrical Elbląg

There is probably no other city in Poland where you can so often come across abstract sculptures inspired by geometric forms. They can be seen in the streets, car parks and squares. The first sculptures emerged in Elbląg in the mid 1960s, created by artists with the involvement of workers. This is probably the reason for their crude, geometric shapes.
New sculptures appear in Elbląg from time to time. The author of one of them, "Panta rei", admits that although he studied art, he was always fascinated by mathematics, which is an inspiration for practically all his works.

K-dron, Art Center Galeria EL, Elbląg, 6 Kuśnierska Street

Foam, Plac Słowiański, Elbląg

2nd Photo: Wikipedia.pl, Jakub Strzelczyk
1st Photo: Beata Ciesielska, private collection.

29. Crypt of Nicolaus Copernicus

For years, historians had no doubt that Nicolaus Copernicus, the prominent Polish astronomer and mathematician, was buried in Frombork Cathedral. However, for nearly 200 years, it was impossible to identify his exact place of rest. This was only possible in 2005, when the graves of the canons of Frombork Cathedral found under the floor were examined. The research proved the authenticity of the astronomer's remains, and in 2010 he was laid to rest in a separate crypt within the church.

Solar system ovet the Nicolaus Copernicus tomb in the Cathedral --→

Monument of the Nicolaus Copernicus in the Market Square in Frombork ↓

Photo: Magdalena Ciesielska, private collection.

In Frombork, we can also find a restaurant - Copernicus House, and a museum dedicated to the astronomer nearby.
In the Cathedral Bell Tower, also known as the Radziejowski Tower, the Foucault's pendulum commanding the rotation of the Earth around its axis can be seen, and from the observation point there is an outstanding view of the Cathedral and the Vistula Lagoon.

Stairs to the Cathedral Bell Tower

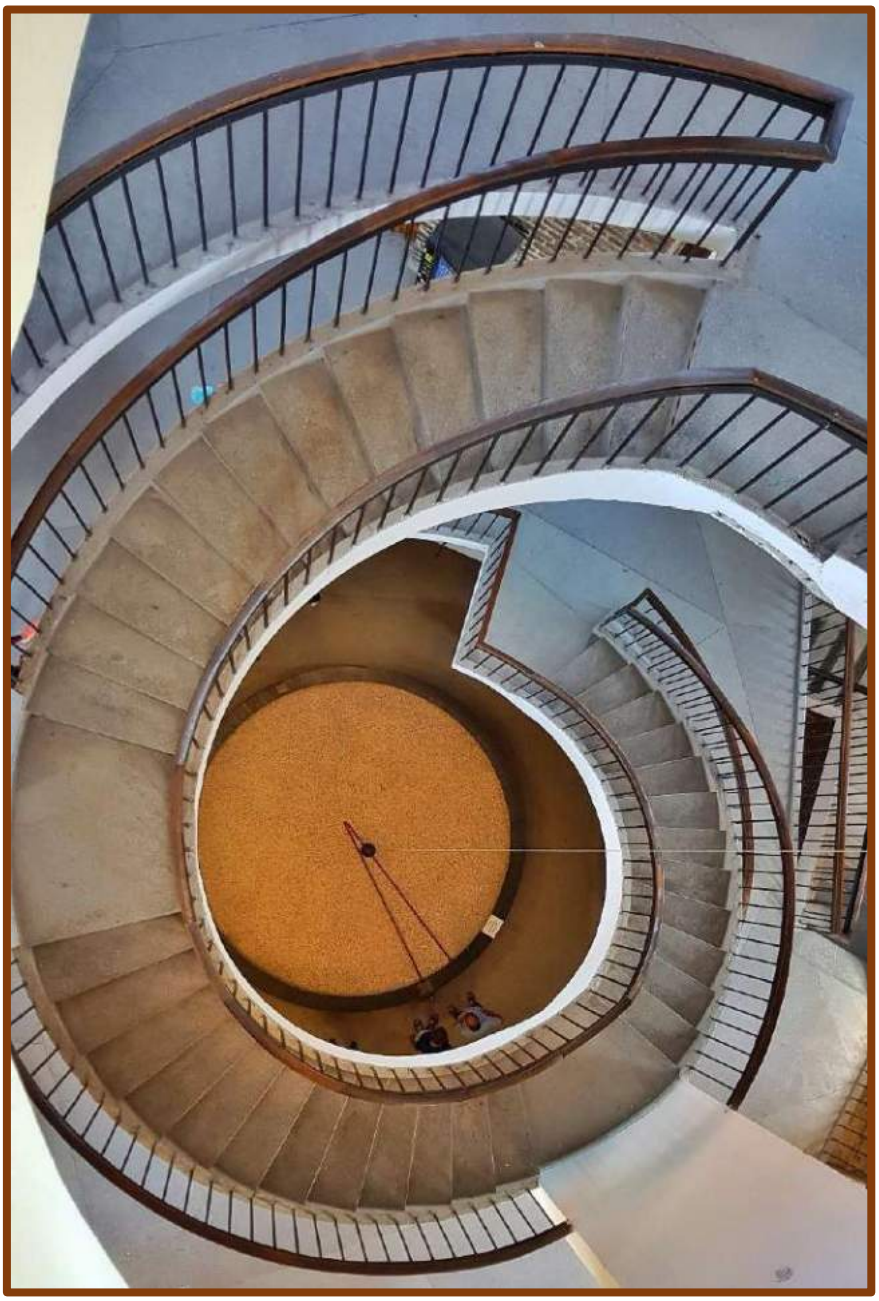


Photo: Magdalena Ciesielska, private collection

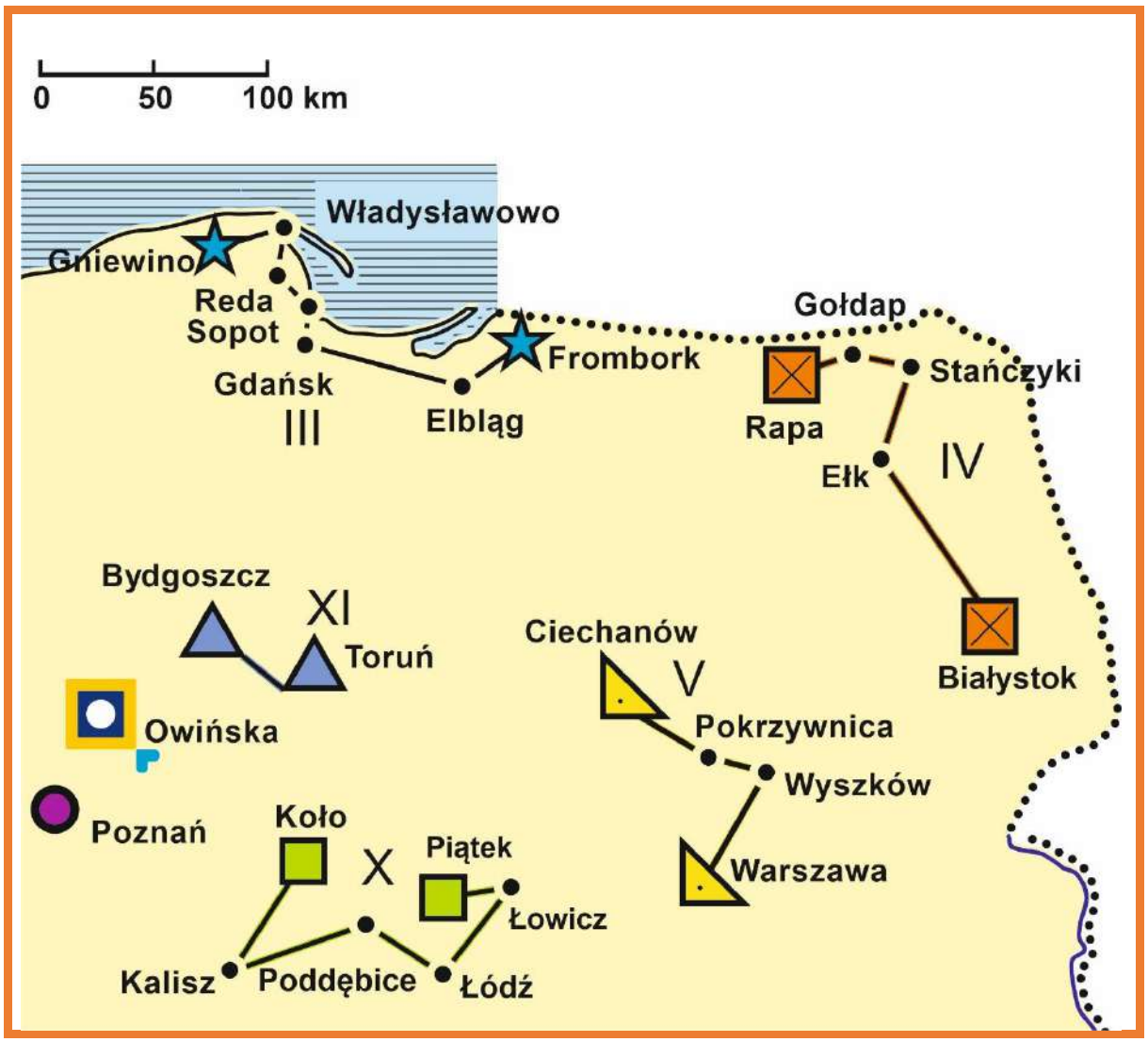
ROUTE NO. IV

Figures known and unknown

The route covers Podlaskie Province and part of Warmińsko-Mazurskie Province:

- **Rapa,**
- **Gołdap,**
- **Stańczyki,**
- **Ełk,**
- **Białystok**

The map of northeast Poland



Drawing by Magdalena Ciesielska

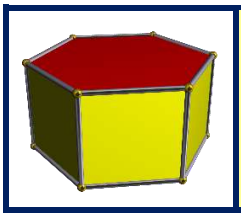
based on a map from the typhlological Atlas of Polish
(Main Office of Geodesy and Cartography, Main Board of PZN)

30. Pyramid in the centre of Masuria

More soaring than those seen in Egypt, the pyramid at Rapa has the same balanced proportions, wall angles and even, some say, a shape and location that facilitates mummification of corpses.
The supernatural powers of the pyramid are a matter of faith. That mathematical calculations were used in its construction is simply a fact. The pyramid in Rapa is a pyramid with a base side of 10.4 metres and a height of 15.9 metres. The angle of inclination of the inner vault is identical to the Egyptian pyramids. The pyramid was built in the early 19th century as a tomb of the Farenheit family.

Pyramid in Rapa, 19-530 Rapa

Photo: Wikipedia.pl, mzopw



31. With a view of Gołdap

Prisms are not solids of rotation and every pupil at the end of primary school knows that. However, at the top of Piękna Góra in Konikowo, a few kilometres from Gołdap, there is a rotating prism that contradicts the laws of geometry. Its café is one of the biggest tourist attractions in the region. A full rotation of the café takes 50 minutes, during which, without moving from your seat, you can admire the beautiful panorama of the surrounding area with the Romincka Forest and the town of Gołdap. The café can be reached by a chairlift, and apart from the café, there is also accommodation on site.

The rotating observation cafe „Bocianie Gniazdo”, Piękna Góra, Konikowo 11.

Photo: Magdalena Ciesielska, private collection

Photo: Magdalena Ciesielska, private collection

32. A view like in Rome

Roman aqueducts are still examples of remarkable architectural art today. However, you do not have to travel that far to admire such structures. The railway bridges in Stańczyki are strikingly similar to those built in Italy.
The structures in Stańczyki, despite their great similarity to aqueducts, performed a completely different role - they were railway viaducts. The ferroconcrete structure, with perfect proportions, is 180 metres long and more than 36 metres high, consisting of 5 regular spans. The beautiful arches, with a radius of 15 metres, resemble a function graph.
Today the 2 parallel bridges attract extreme sports enthusiasts who use them for bungee jumping.

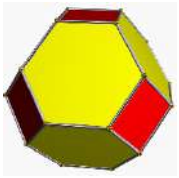
Viaducts in Stańczyki

Photo: Wikipedia.pl, Damian Pankowiec

Historic bridges and magnificent landscapes can be admired from the nearby 20-metre-high observation tower. The tower was built on a regular 18-sided plan. The futuristic hyperboloid shape is the result of 36 arched and intersecting wooden supports.
From the tower you can see the Tobellus Lakes, the watershed of the Błędzianka Valley and historic railway bridges. You can also listen to the relaxing sounds of nature and feel the wind in your hair. Admission to the tower in Stańczyki is free.

Observation Tower, Stańczyki

Photo: Wikimedia.pl, MOs810



33. Educate yourself with Copernicus

In Ełk there is an Educational Park named after Nicolaus Copernicus. The name dictates, so there is a solar system in the park, whose central point is the sun with a diameter of 170 centimetres. Other planets with plaques showing their mass, diameter and distance from the sun are also very remarkable. However, this is not all that the Park has to offer. From a mathematical point of view, the Novum playground is interesting, where you can not only have fun, but also take a close look at Archimedes' solid - the truncated octahedron. Finally, everyone can sit on a bench next to a life-sized sculpture of Nicolaus Copernicus.

The Nicolaus Copernicus Education Park,
Ełk, Wojska Polskiego Street

Photo: Collection of the City of Ełk

34. Opera in a hat

Some people see a hat, others an umbrella, and even a flying saucer in the open-work construction above the entrance to the Białystok opera house. Illuminated at night, the cuboid-shaped body of the opera house, together with the spiral staircase (like a helicoid) leading to the terrace, looks spectacular.
In addition to concerts, the Opera House, with an audience of 600, may also be used for theatre performances or conferences.

Podlasie Opera and Philharmonic - Stanisław Moniuszko European Centre for the Arts, Białystok, 1 Odeska Street

Photo: Wikipedia.pl, Luis Moreira

Photo: Wikipedia.pl,

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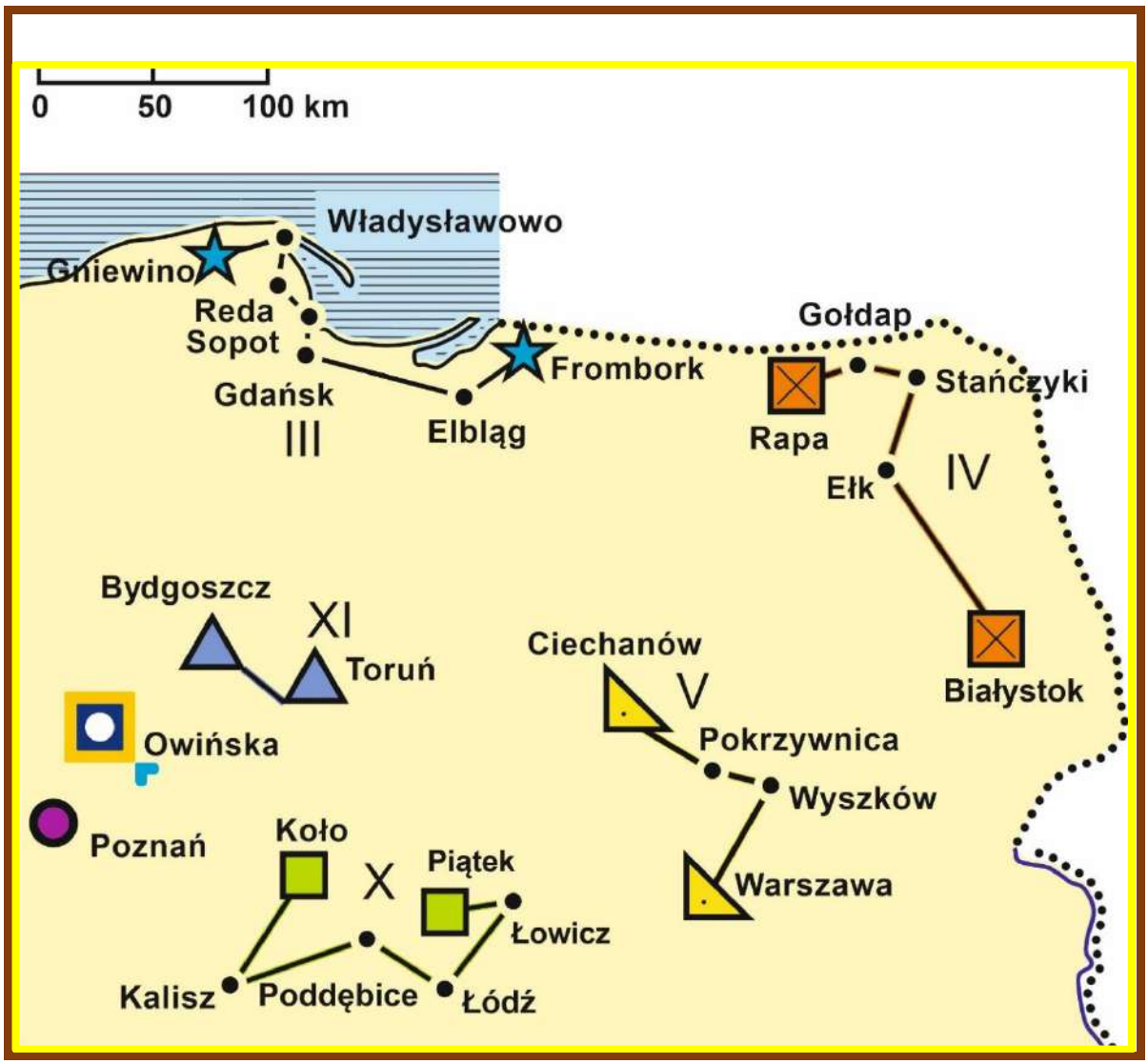
ROUTE NO. V

Great Polish mathematicians

The route covers the Mazowieckie Voivodeship:

- **Ciechanów**
- **Pokrzywnica**
- **Wyszków**
- **Warszawa**

The map of northeast Poland



Drawing by Magdalena Ciesielska

based on a map from the typhlological Atlas of Polish
(Main Office of Geodesy and Cartography, Main Board of PZN)

35. The tyre or torus

The locals call it a mushroom or a tyre. Mathematicians, on the other hand, will notice a torus placed on a hyperboloid. Since 2014, the tower in Ciechanów has been included in the register of monuments of technology. Originally the tower served as a water reservoir, and today it is a symbol of the Torus Science Park.
It is hard to find a better symbol for a place which aims to popularize science. The thoroughly mathematical construction is at the same time full of imagination and flair. Just like the offer of the Park, which enables visitors to gain knowledge about physics, mathematics, technology and architecture on their own. Here, learning takes place through play and experience.

Torus Science Park, Ciechanów, 34 Płocka Street

Photo: Magdalena Ciesielska, private collection

36. Vegetarian because of triangles

The theorem about right-angled triangles, the discovery of the regular dodecahedron, and the evidence that the sum of angles in a triangle equals 180 degrees - are only a fraction of what Pythagoras contributed to mathematics. For those running Café Pythagoras in Ciechanów, the fact that the great scientist was declared vegetarian is no less important.
Café Pythagoras is located opposite the Torus Science Park and, as may be expected of a place whose patron is a vegetarian, there is a meat-free menu.

Pitagoras Cafe, Ciechanów, 34 Płocka Street

Photo: Magdalena Ciesielska, private collection

37. Like a gateway to paradise

The first connotation that comes to mind for many people who stand in front of the entrance to the Church of Our Lady of the Scapular in Pokrzywnica is that it recalls the image of the entrance to Paradise, perpetuated in Christian symbolism. A perfect soaring parabola decorated with a stained glass window of the same shape.
This temple, completed in 1984, in the shape of a hyperbolic paraboloid, appears to consist of arches only. Even its roof seems to rise smoothly towards the sky. The only thing distinguishing this shape is the cross built next to it, which towers over the church and serves as a belfry.

Church of Our Lady of the Scapular,
Pokrzywnica, Jana Pawła II Avenue 1

Photo: Magdalena Ciesielska, private collection

38. Wyszków in honour of the cryptologist

Sometimes it is worth sitting next to someone, especially if that person has an exciting story to tell. The same conclusion must have been drawn in Wyszków, where a sculpture of sitting Jerzy Różycki was placed among the trees of the park named after Karol Ferdynand Waza.
This outstanding Polish cryptologist took his final high school exams in Wyszków and it was this very fact that the town authorities decided to honor. Wyszków was only the beginning of his scientific career, which was crowned by his participation in a group of mathematicians who managed to break the German Enigma cypher, considered impossible to decipher.

The bench of Jerzy Różnicki,
Karol Ferdynand Vasa Park, Wyszków, 3 Maja Street

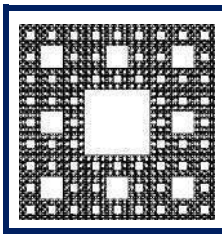
Photo: Wikipedia.pl, Pineska64

39. Tea room to the cube

The "Tea House" sculpture in the form of a cube set on one of the edges is one of the most spectacular objects in Bródno Park. It is one of the most spectacular objects, particularly because, firstly, it was made of materials in which the surrounding landscape is reflected, and secondly, during the festivities you can drink tasty tea or coffee there.
This is not the only sculpture on the site to be inspired by geometry. Among the objects, you can find spheres, triangles, and even a gate to paradise, which is formed by two trees shaped in a symmetrical parabola. After tracing all the mathematical traces in Bródno Park, you can simply have a nice time. There is no lack of playgrounds for children, and charming paths, while in summer you can seek refreshment by the fountains.

Bródno Sculpture Park, Warsaw, Chodecka Street

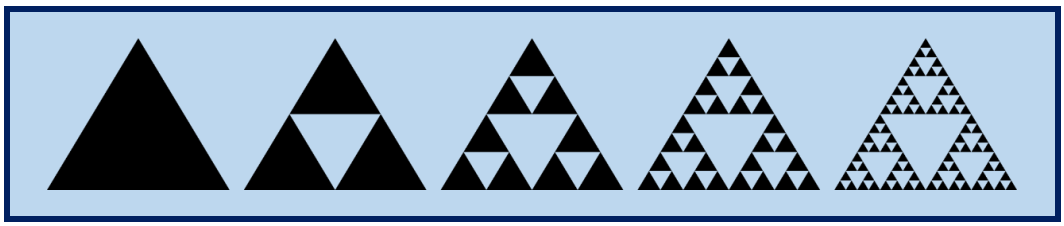
Photo: M, P. Ciesielscy, private collection



40. Mathematicians from the capital

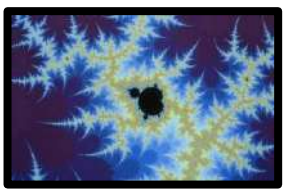
Warsaw is the birthpalce of many prominent Polish mathematicians, world-renewed professors:

- **Samuel Dickstein** (1851 – 1939) – president of the Polish Mathematical Society and founder of the journal Wiadomości Matematyczne;
- **Wacław Sierpiński** (1882 – 1969) - best known for Sierpiński's Triangle and Diva, founder of the Polish School of Mathematics, cryptologist;

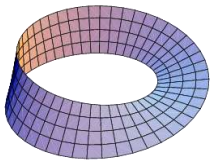


Rys. Wikipedia.pl, Saperaud

- **Stefan Mazurkiewicz** (1888 – 1945) – cryptologist and mathematician, associated with the Polish School of Mathematics;
- **Kazimierz Kuratowski** (1896 – 1980) - Prominent member of the Warsaw School of Mathematics, Vice-President of the International Mathematical Union;
- **Benoit Mandelbrot** (1924 – 2010) - father of fractal geometry;



Drawing: Wikipedia.pl, Michelmset



41. Mathematical playground

If math is all around, why should it be missing from a playground? Following the mathematical trail, it is worth taking a short break and relaxing on the playground in Kępa Potocka park. A mathematician will easily spot a hexagonal prism, spiral slides and even a Möbius strip which symbolizes infinity in the playground objects.

Kępa Potocka Park, Warsaw, Gdansk Coast 27

Photo: Magdalena Ciesielska, private collection

42. Cryptologists at Powązki Cemetery

Warsaw’s Powązki cementery is the resting place of many notable Poles. It is here, on Powązkowska Street, that the tombs of:

- **Wacława Sierpińskiego** (Merit Alley, row 1, site 10, tomb 153),
- **Stefana Mazurkiewicza** (plot 41-2-24,25)
- **Mariana Rejewskiego** (plot B-39, 4-3).

These three outstanding mathematicians are connected by the fact that they were all also among the best cryptologists of their time.
Marian Rejewski became famous for being a leading member of the team that cracked the German Enigma cipher and, after changing the way messages were encrypted, constructed a cryptologic bomb. 20 years earlier, during the Polish-Soviet War, Wacław Sierpiński and Stefan Mazurkiewicz had been engaged in breaking Soviet ciphers.
Sierpiński's grave has the inscription "Researcher of Infinity" and Mazurkiewicz's tombstone has the words: "He did not die. He only finished commanding".
Also buried in the same cemetery was

- **Kazimierz Kuratowski** (plot B32-tuje-1).

Buried in the Jewish cemetery on Okopowa street in Warsaw was:

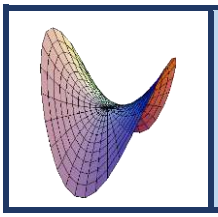
- **Samuel Dickstein** (plot 20, alley 4).

43. Warsaw Spire

An office building in the shape of a hyperboloid narrows in the middle of the structure, to form a wide ellipse at the top. Warsaw Spire is not only one of the most original, but also one of the highest buildings in Europe.
The numbers with which it can be described are truly spectacular. Together with the 40-meter high spire that crowns the building, Warsaw Spire is 220 meters high and has an area of over 100 thousand square meters. The hyperboloid fountain in front of the building is a clear reference to the original shape of the estate. In order to see it, it is worth going there in the evening, when the illuminated water streams create an incredible spectacle.

Warsaw Spire, European Square

Photo: Wikipedia.pl, AGC Glass Europe



44. Historic paraboloid

In the registry of historical monuments, the Warszawa Ochota station looks a bit like an eccentric relative who turns up at a formal dinner in jeans and a short-sleeved shirt worn under a suit. The element that made this particular building a part of the list of historical monuments is its great roof, which people associate with a bent piece of paper, while others with a sail. In reality, it is simply a representation of a hyperbolic paraboloid. The Ochota station is another excellent example of the use of mathematics in architecture.

Ochota Railway Station,
Warsaw Wola, 58 Jerozolimskie Avenue

Photo: Wikipedia.pl, Panek

45. Geometric chameleon

The office building located in Warsaw at 89 Chmielna Street is a veritable architectural and geometric chameleon.
The glass-covered façade of the building reminds a bit of a crystal, viewed from different directions it has a completely unique shape.
The most irregular and three-dimensional shape is seen from Chmielna Street. After crossing Jerozolimskie Avenue, it presents itself as a classic cuboid, and from the side of Ochota station, a rectangular trapezoid is visible in the facade.

Warszawa, 89 Chmielna Street

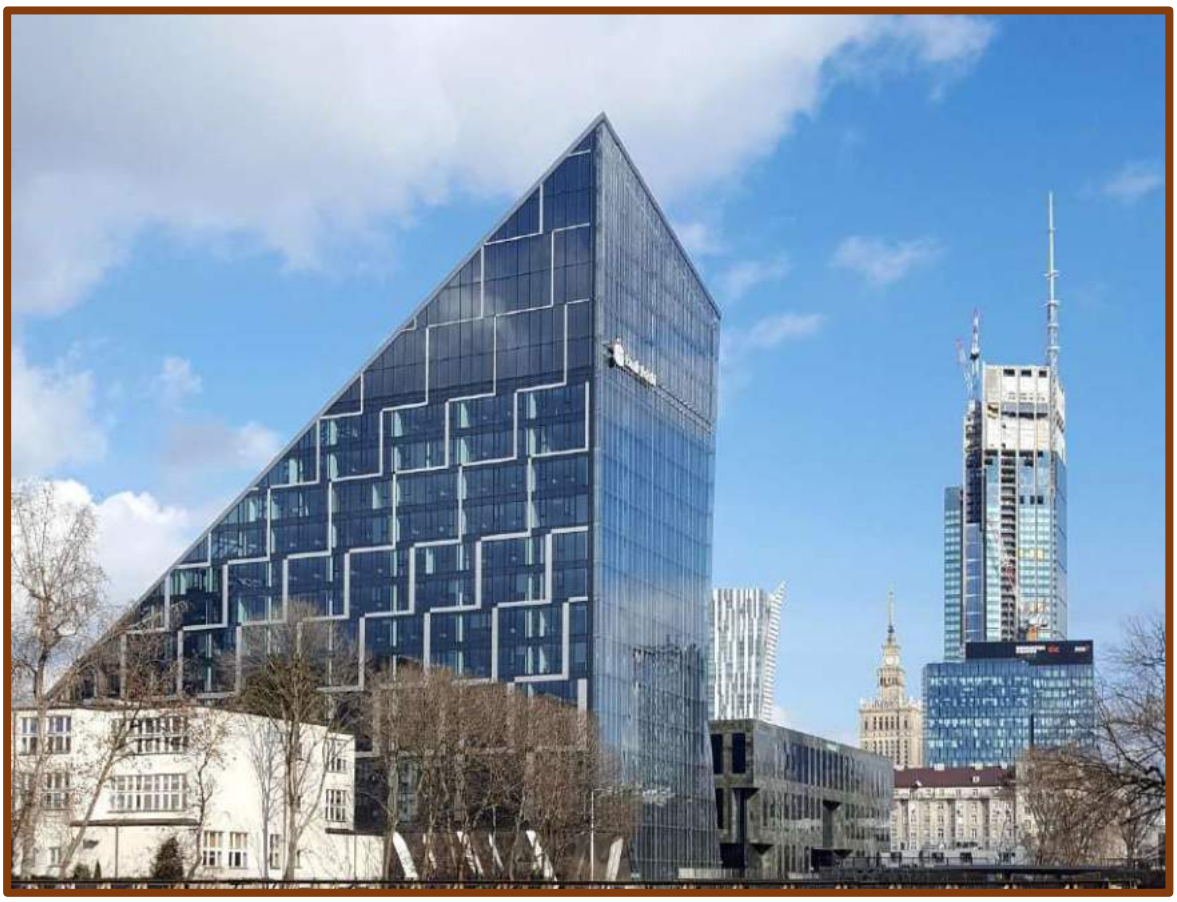
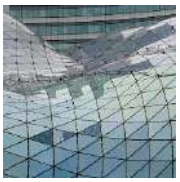


Photo: Wikipedia.pl, Wistula



46. Triangular terraces

Warsaw's Golden Terraces were always intriguing even at the moment of their construction. Few people could have imagined what an openwork construction made of thousands of triangles would look like. The facility, located near the Palace of Culture and Science, makes an incredible impression even today, 15 years after its completion.
The spectacular design of the seven interconnected hemispheres was achieved by using a geodesic dome model for the roof, which reproduces the surface of a sphere.
The geometric element used to create it is usually an isosceles triangle approximating an equilateral triangle. Zlote Tarasy is an excellent example of how the use of mathematics can help create unique architectural forms.

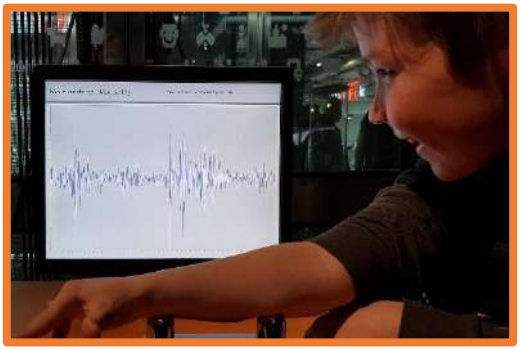
Golden Terraces, Warsaw, Złota Street

Photo: Wikipedia.pl, Adrian Grycuk

47. Copernicus Science Centre

In such places, it turns out that science can be a thrilling adventure for students of all ages. Learning through experience, and experiment, supported by a multimedia presentation. When going to the Copernicus Science Center, you need to book at least a few hours for a stay here, and anyway, you will have to choose from the dozens of attractions which this place offers.
Mathematicians will particularly enjoy the "Chaos and Harmony" show, which is an amazing display of three-dimensional images of fractals, geometric figures, solids and cycloids. Watching this incredible show, it is hard not to agree with Galileo Galilei's words that mathematics is the alphabet by which God described the universe.

Copernicus Science Center,
Warsaw, 20 Wybrzeże Kościuszkowskie Street



1st Photo: M. Ciesielska, 2nd Photo: Wikipedia.pl, Staszek99

48. A milestone cryptologists

The honour of Milestone is awarded to the most outstanding scientists whose discoveries have contributed to the advancement of mankind. Among those who have been awarded this honour are Nikola Tesla, Thomas Edison and Alexander Bell. This exclusive group also includes Polish scientists from the Polish Cipher Bureau. Marian Rejewski, Jerzy Różycki and Henryk Zygalski, by breaking the Enigma codes, saved hundreds of thousands of people and made World War II end sooner.
The stone is placed in front of the Institute of Mathematics of the Polish Academy of Sciences in Warsaw and the engraving on it stresses the merits of the Polish mathematicians and their contribution to breaking the German cypher, which many considered to be unreadable.

Milestone, Warsaw, 8 Śniadeckich Street

Photo: Wikipedia.pl, Pineska64

A beautiful mural at the entrance to the Stokłosy underground station was created in honor of the three eminent cryptologists.

The houses where the Polish mathematicians lived were also memorialized with plaques.
In 1932 **Marian Rejewski** lived at 20 Adama Mickiewicza Street and later at 2 Gdańska Street.

Photo: Wikipedia.pl, Marcin Mieducki

Jerzy Różycki lived at 4 J. P. Woronicza Street from 1937 to 1939.

Photo: Wikipedia.pl, E. Szczuka

49. Delicious $\frac{common}{denominator}$

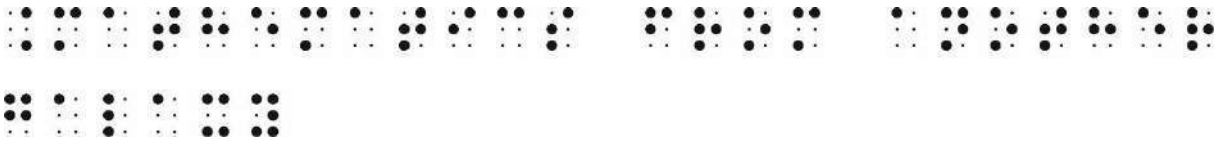
A tourist does not live by sightseeing only! But even when hunger hits, you can satisfry it in a mathematical style.
At the Pancake House, even students who, on a daily basis, have trouble with fractions can easily find a dish to their taste.

Pancake House Wspólny Mianownik,
Warsaw, 126 Ostrobramska Street

Photo: Naleśnikarnia Wspólny Mianownik, private collection

ROUTE NO. VI

Mathematics from another galaxy



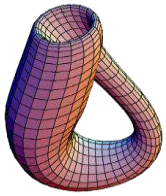
The route covers the Lubuskie, Świętokrzyskie and part of the Mazowieckie Voivodships:

- **Zamość**
- **Emilcin**
- **Radom**
- **Kielce**

The map of southeast Poland

Drawing by Magdalena Ciesielska

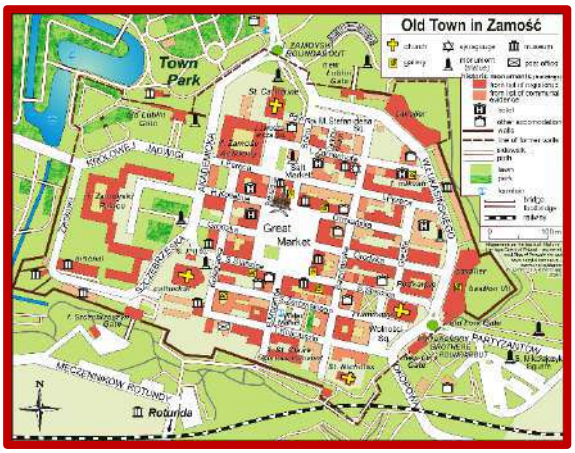
based on a map from the typhlological Atlas of Polish
(Main Office of Geodesy and Cartography, Main Board of PZN)



50. Magical and unique City of Zamość

Since 1992 Zamość has been on the UNESCO World Cultural and Natural Heritage List. Despite the centuries Zamość has maintained its original spatial structure with a chequered street layout and a plan of an extended pentagon, which as a result of the need to adapt its shape to the relief of the land resulted in a seven-sided layout.
Apart from the unique spatial layout in Zamość, there is also the only one in Poland, and possibly in the world, a monument of the "Klein Bottle". Its cosmic shape, first described in 1882 by Felix Klein, allows the bottle to be turned upside down without spilling its liquid contents. The monument is located on the premises of the Zamojska Academy on Zamojskiego Street.

Plan of the Old Town of Zamość,



Klein Bottle Monument

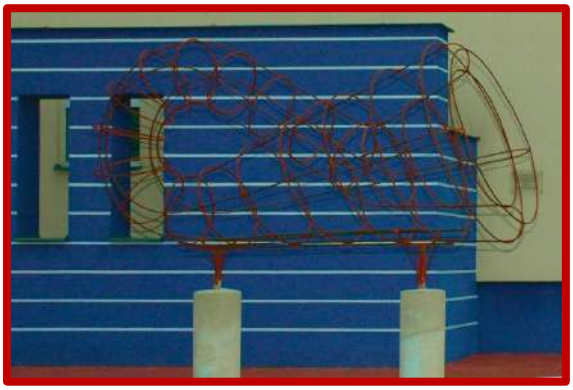


Photo: Wikipedia.pl, MaKa~commons

51. Cube as a symbol for UFO

The cube, polished and gleaming in the sunlight, placed on a stone pedestal commemorates the events that allegedly took place in Emilcin in 1978. It was here, on 10 May, that an Unidentified Flying Object was to land and one of the villagers was to meet its occupants.
A time capsule was buried at the monument in 2011, which is to be opened in 3011.

Ufo Statue, Emilcin

Photo: Wikipedia.pl, Lukke

52. The flourishing temple

Were it not for the cross on top, it would be difficult to guess that the building situated in the very heart of a housing estate in Radom has a sacred purpose. It rather resembles a giant flourishing plant towering over the surroundings or a half-open extraterrestrial ship.
Inspired by the Gothic style, the construction is completely modern. The mass of the Church of Our Lady Queen of the World amazes with its symmetrical, simple structure formed by slightly rounded triangles and connected by narrow skylights. In 2010, i.e. two years before its opening, the church in Radom was named one of the 10 most beautiful churches in Poland in a competition organized by the magazine "Polityka".

Church of Our Lady Queen of the World
Radom, Grzybowska Street

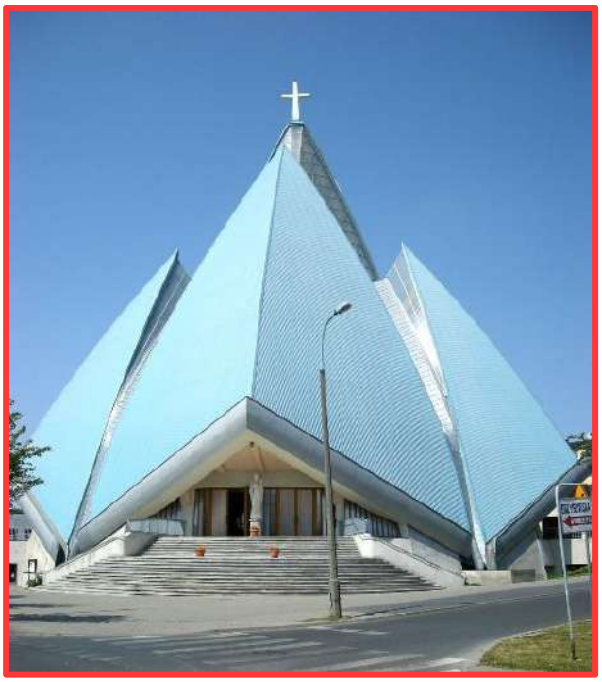


Photo: Wikipedia.pl, Przemysław Jahr

53. Cosmic bus station in Kielce

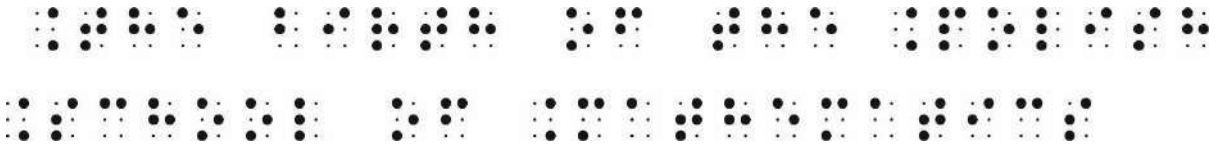
The outer circular ring, the centrally placed cylinder and the towering semicircular dome form a shape that is strongly associated with our idea of what Unidentified Flying Objects look like. The Kielce Bus Station is one of the most peculiar locations in the city.
When the idea of destroying the building of the station appeared, the inhabitants protested. As a result, the facility was modernised, keeping its original shape, and new finishing materials and lighting emphasised its futuristic and cosmic character.

Bus Station, Kielce

Photo: Magdalena Ciesielska, private collection.

ROUTE NO. VII

The birth of the Polish School of Mathematics



The route covers the Małopolskie and Podkarpackie Voivodships:

- **Kraków,**
- **Tarnów,**
- **Jasło,**
- **Zagórzany,**
- **Wola Krogulecka.**

The map of southeast Poland

Drawing by Magdalena Ciesielska

based on a map from the typhlological Atlas of Polish
(Main Office of Geodesy and Cartography, Main Board of PZN)

54. Polish Mathematical Association

The capital of world mathematics in the inter-war period was situated in Poland, in the beautiful city of Lviv. The Polish Mathematical Society of Lwów was established there in 1918. The group of leading mathematicians who developed functional analysis was later called the Lviv School of Mathematics, and its founders Stefan Banach and Hugo Steinhaus are regarded as classics of mathematics on an international scale. And it was in Krakow that they met. It was also here that many of the professors were killed during the Second World War. Some of them managed to leave in time, to save their lives. Władysław Orlicz founded the Poznan School of Mathematics. The Warsaw School of Mathematics was mainly concerned with the theory of multiplicity, logic and topology, while the Krakow School of Mathematics was dedicated to the theory of differential equations, analytic functions and differential geometry.

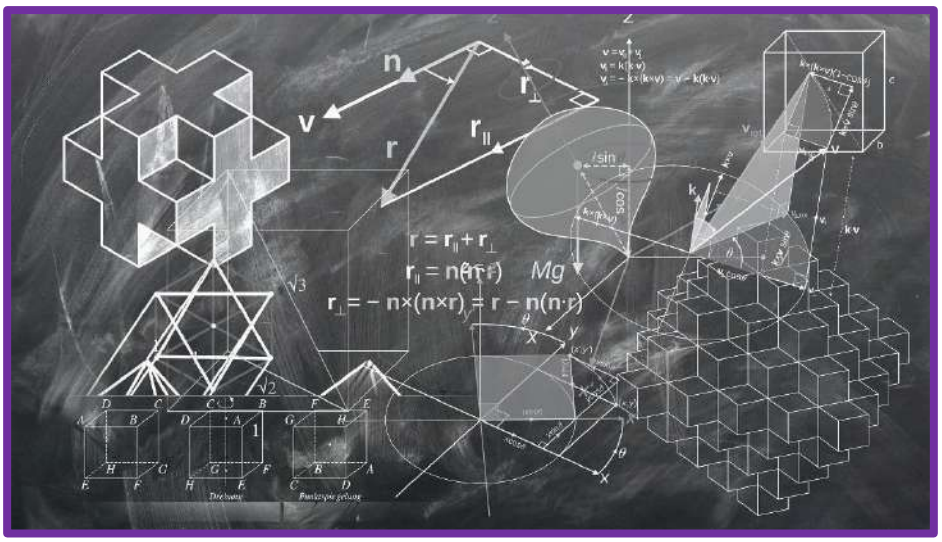


Photo: Pixabay, Geralt

55. Mathematical mural

The most significant achievements of Krakow mathematics from the 17th century, until its most recent discoveries, are presented in a huge mural created on the terrace of the Faculty of Mathematics and Computer Science of the Jagiellonian University. When composing his work, its author, Ryszard Paprocki, used the anamorphosis technique, i.e. a bizarre perspective.
Besides being inspired by Krakow's achievements, the mural is full of allusions to fractals, prime numbers and the golden ratio. Finding all the connotations can take up to several hours. On the metal bars above the terrace are the most famous formulas of mathematics, as well as a warning known from Plato's academy: "Whoever does not know geometry, let him not enter under this roof".

Mural at Jagiellonian University, Kraków, 6 Łojasiewicza Street, 2nd floor, left wing

Photo: gazetakrakowska.pl, private collection

Not far from it, you can take a rest at the mathematical fountain built on a triangular plan. It is composed of a cylinder, a sphere, a cone and a rotating cube.

Fountain by the Faculty of Mathematics and Computer Science of the Jagiellonian University,
6 Łojasiewicza Street

Photo: Magdalena Ciesielska, private collection

56. Kościuszko Mound

When standing under Kościuszko Mound, which is over 35 meters high, it is hard to imagine the work done by the people who created it. During the three years of its construction, a significant part of the work was performed by volunteers; even a symbolic participation in its excavation became a patriotic duty; even foreigners visiting the city took part in it.
The result is a cut cone, the diameter of the base is over 73 metres, to reach just under 9 metres at the top. It is on the top of the mound where the observation deck is situated, from which one can admire the view of the panorama of Cracow.
It can be reached by a series of winding stairs which, from a bird's eye view, look like circles of different sizes tangentially wound together.

Kościuszko Mound, Krakow, Malczewskiego Street

Photo: Pixabay.pl, dimitrisvetsikas1969

Stairs to the Kościuszko Mound in the shape of the number 9

Photo: Wikipedia.pl, Anna Książek, Adam Rżysko

57. Bust on the centenary of the birth

The decision to honour Stefan Banach, whose life and scientific work was inseparably linked with Kraków, was taken by the Board of the Kraków Branch of the Polish Mathematical Society in 1992, i.e. on the centenary of the eminent mathematician's birth. The statue, which was cast in bronze, was produced thanks to donations from private donors and scientific institutions from all over Poland. The statue is located on the square in front of the former building of the Institute of Mathematics and Physics of the Jagiellonian University at 4 Reymonta Street, and its inauguration took place on 30 August 1999.

Statue of Stefan Banach, Kraków, 4 Reymonta Street

Photo: Wikipedia.pl, Paweł Świegoda

58. Legend of a mathematical bench

Two figures in bronze, immersed in conversation on a bench in the Planty Park in Krakow, are Stefan Banach and Otto Nikodym. The original sculpture recalls Banach's meeting with Hugo Steinhaus, who used to say that his biggest mathematical achievement was the discovery of Banach. This is what he said about him: "Genius - gene and already".
An explanatory plaque has been installed on the stone next to the bench. The inscription on it states:: "On a summer evening in 1916, two young Cracovians, Stefan Banach and Otto Nikodym, were talking about mathematics on a bench in the Planty. Dr Hugo Steinhaus, a mathematician who was passing by, joined the discussion. This is how the extraordinary mathematical talent of Stefan Banach, one of the most important Polish scientists, was discovered". The bench itself is carved with a formula which is the solution to the problem Steinhaus told Banach about during their meeting in the Planty.

Banach and i Nikodym Bench,
Krakowskie Planty, near Podzamcze Street

Photo: Magdalena Ciesielska, private collection

59. In honour of the murdered

On the night of 3-4 July 1941, a special division of the German Reich conducted a brutal arrest of twenty-two professors from Lviv universities (Lviv was then within the borders of Poland). Altogether 52 people were arrested. They were murdered a day later.
A memorial plaque in honour of the Lviv professors is located in the Franciscan Monastery Church at 5 Wszystkich Świętych Square, Franciszkańska Street 2.
Among the victims we can find such names as:

- **Włodzimierz Stożek** – professor of mathematics at the Lviv Polytechnic,
- **Antoni Łomnicki** - professor of mathematics at the Lviv Polytechnic,

On 12 July murdered were:

- **Stanisław Ruziewicz** - professor of mathematics at the Academy of Foreign Trade

On 26 July shot to death:

- **Kazimierz Bartel** - professor of mathematics, Head of the Department of Descriptive Geometry at the Lviv Polytechnic.

To Their memory.

60. Mariacki fractals

Fractals are self-similar figures (i.e. figures whose parts are similar to the entire thing). They became popular thanks to Benoit Mandelbrot's work "The Fractal Geometry of Nature", published in 1982. In reality, fractals have been used in architecture for thousands of years, especially in India, but there are also many such examples in Poland. One of them is the finial of the tower of St. Mary's Church in Krakow. The taller, 82-meter tower, known as the Heljnalica, is built on a square plan, which, at the height of nine floors, turns into an octagonal prism with ogival windows. The whole is ornamented with a fractal arrangement of the turrets consisting of an octagonal pyramid encircled by a ring of eight smaller and tiny turrets of the same shape. From the tower, from the height of 54 meters, the Marian bugle is played every hour. It is one of the symbols of Krakow.

Hejnalica of St, Mary’s Church, Kraków, Mariacki Square 5

Photo: Wikipedia.pl, Barbara Maliszewska

61. Lunch for the job

The idea was simple. Anyone who solved the mathematical task hanging on the front door of the "Anatomia" restaurant would get dinner for free. In a short time, math students received dozens of free portions, and the tasks on the restaurant's door became more and more complicated. In the restaurant, apart from delicious Georgian cuisine, mathematics reigns supreme. On one wall there are mathematical graphs (Fibonacci spiral), the other one is covered with sheets with solutions to subsequent mathematical tasks. On one of them the task is written in the Braille alphabet.

Graphics in Anatomia Restaurant,
Kraków, 25 Dajwór Street

Photo: Magdalena Ciesielska, private collection

62. Lem - patron of experiences

On 6 hectares at 68 Peace Avenue in Krakow, an incredible Garden of Experience has been created, whose patron was the writer and visionary, born in Lviv, but connected to Krakow, Stanisław Lem. Within the garden, there are 110 objects through which everyone can learn the laws of acoustics, hydrostatics, mechanics and also mathematics. You can find there, a breathing rectangle, a wandering wheel, magic cones, a spiral and a sinusoid. This unique place in Krakow is not only an opportunity to gain knowledge through play and experience, but also to relax and have a rest while exploring the city.

Stanisław Lem Garden of Experiences in the Polish Aviators Park, Kraków

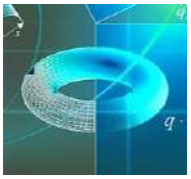
Photo: Wikipedia.pl, Krzyycho

63. City on the Pole

The wonderfully located Tarnów impresses not only with its charming streets and monuments. It is a wonderful place for all those who love summer and sunshine. In the town on the Dunajec River, called the Polish heat pole, summer temperatures last almost 120 days a year.
The calculations were made by the Institute of Meteorology and Water Management. They show that Tarnów, located on the Carpathian Foothills, is the warmest city in Poland.
The Town Hall on the Old Market Square is worth a visit. A plain cuboid shape with a cylindrical tower topped with an octagonal pyramid.
Here, in Tarnów, Władysław Orlicz - a prominent mathematician, and founder of the Poznan School of Mathematics - began his education.

Tarnów Town Hall, Old Market Square 2

Photo: Wikimedia.pl



64. Water Tower Bania

The locals call it "bania", which, in a sense, has to do with the purpose of the object built in the 1980s. Rising to a height of 37 meters, the tower is made of 24 columns in the shape of a hyperboloid and topped with a giant torus - a water tank for housing estates. It is the only facility of this type in Poland that is used for its original purpose. Other water towers in our country are deteriorating or have been converted into viewing terraces.

Water Tower Bania, Tarnów, 28 Jasna Street

Photo: Wikipedia.pl, Andrzej Otrębski

65. Mathematician and humanist

Hugo Steinhaus, born in Jaslo, was not only an eminent mathematician whose works and theories were widely used in biology, medicine and statistics. He was also a humanist, author of aphorisms and the hero of many vivid anecdotes. The house in which he lived from birth, now houses the District Authority Office, while a memorial plaque dedicated to this honorary citizen of Jasło was placed in the Secondary School No I, of which he was a graduate. Every year the school hosts the Hugo Steinhaus Mathematical Competition of Jasło. Also, the traffic circle at the crossroads of Tadeusza Kościuszki and Hugon Kołłątaja streets was named after him.

Secondary School No. I, Jasło, 4 T. Czackiego Street

Photo: Wikipedia.pl, Tadeusz Bienias

66. Egipt in Zagórzany

In Zagórzany there is a building that has been inspired by ancient Egypt. The tomb of the Skrzyński family is an imprecise copy of the famous pyramid of Cheops. It is distinguished from the original by a rectangular base and a cross growing out of the side. The pyramid is 10 meters high.

Tomb of the Skrzyński family, Zagórzany

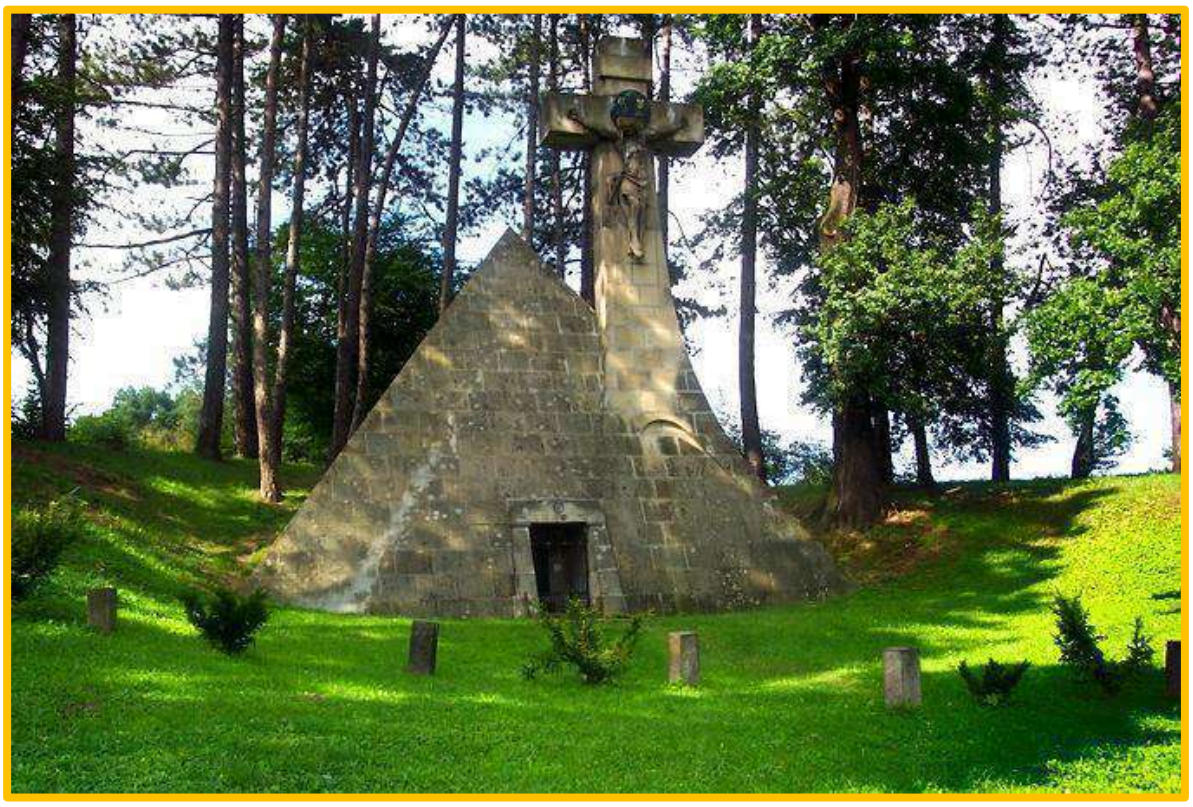


Photo: Wikipedia.pl, Przemekkus

67. Snail with a view

Built in Wola Krogulecka and located on a hill, the viewing platform is extraordinary for many reasons. Although it offers a wonderful view, tourists do not have to climb the steps to admire it.
Rather than a tower, a spiral platform has been built that blends harmoniously into the landscape. A huge benefit of this solution is that it is accessible to the public and has no architectural barriers. People with disabilities and parents with small children can use the platform without any obstacles.

Viewing platform, Wola Krogulecka

Photo: Wikipedia.pl, Rafał M.Socha

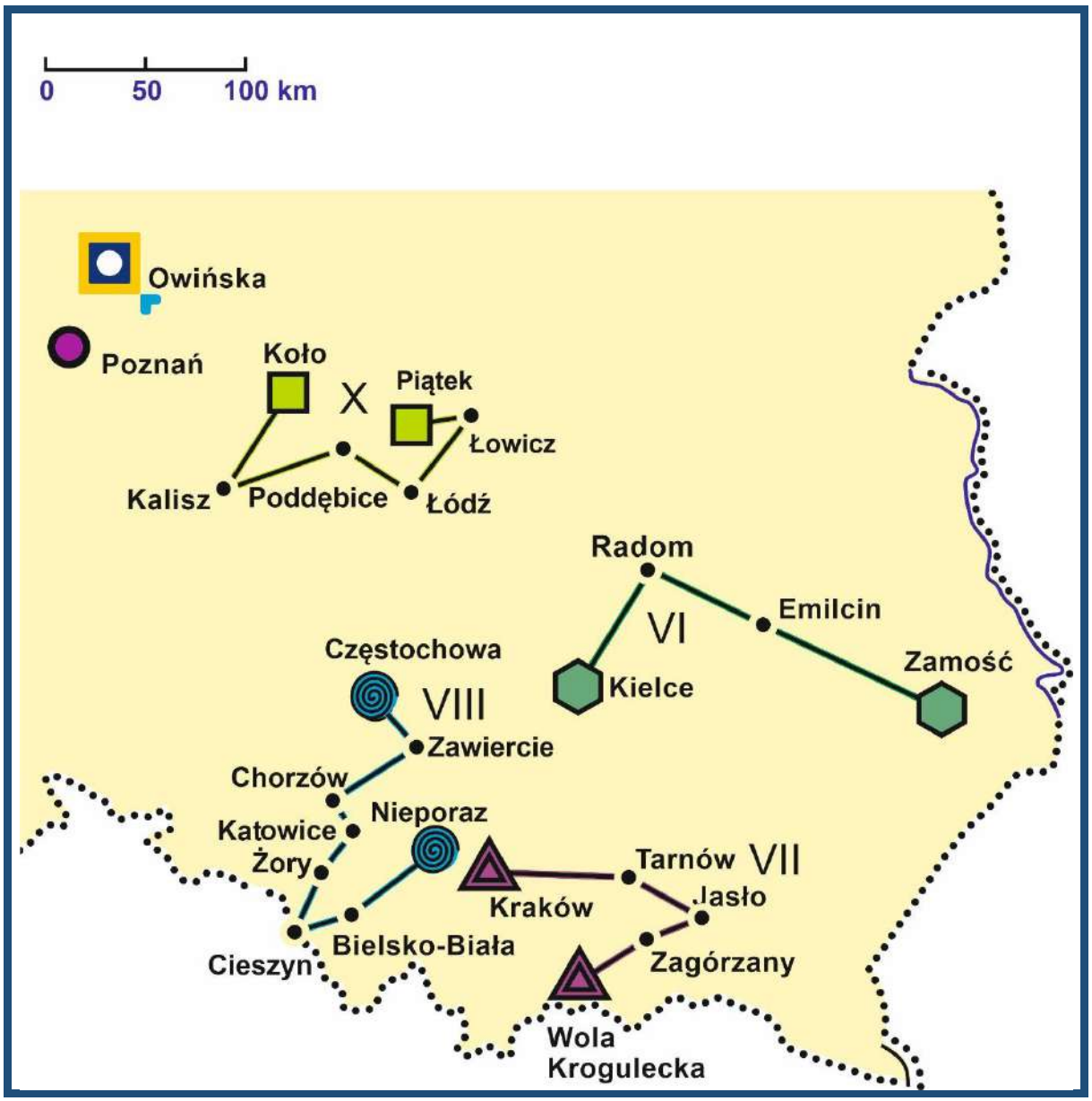
ROUTE NO. VIII

Crazy mathematics

This route includes parts of the Silesian and Lesser Poland Voivodeships:

- **Nieporaz,**
- **Czechowice-Dziedzice,**
- **Bielsko-Biała,**
- **Szczyrk,**
- **Cieszyn,**
- **Żory,**
- **Katowice,**
- **Chorzów,**
- **Zawiercie,**
- **Olsztyn (koło Częstochowy),**
- **Częstochowa.**

The map of south-east Poland



Drawing by Magdalena Ciesielska

based on a map from the typhlological Atlas of Polish
(Main Office of Geodesy and Cartography, Main Board of PZN)

68. Cosmic village

Linked by glass corridors, the domes of different heights and diameters form the most futuristic object in Poland. One can easily picture it as a prototype of a base on Mars. In reality, Alvernia Planet is a huge film studio. The two largest cupolas are 50 meters in diameter and 25 metres high. The height of the smallest is 16 metres, which is the height of a 5-storey building. The whole covers an area of 13 hectares and from a bird's-eye view, it resembles a huge three-dimensional fractal.

Alvernia Studios,
Nieporaz, 1 Ferdynanda Wspaniałego Street

Photo: Wikipedia.pl, Alvernia2013

69. Jump in Parabola

The diagram of the quadratic function called a parabola is the basis of mathematics. For those who have visited the trampoline park "Parabola" in Czechowice Dziedzice it can have a completely different meaning. It is a great place to stop during a visit, where not only the youngest will find amusement. While watching people playing on the trampolines ever-present in this park, you can observe an interesting effect from the verge of mathematics and physics. The heads of the jumping persons draw a parabola shape in the air. Mathematics is truly all around.

Parabola Trampoline Park,
Czechowice-Dziedzice, 4 Elizy Orzeszkowej Street

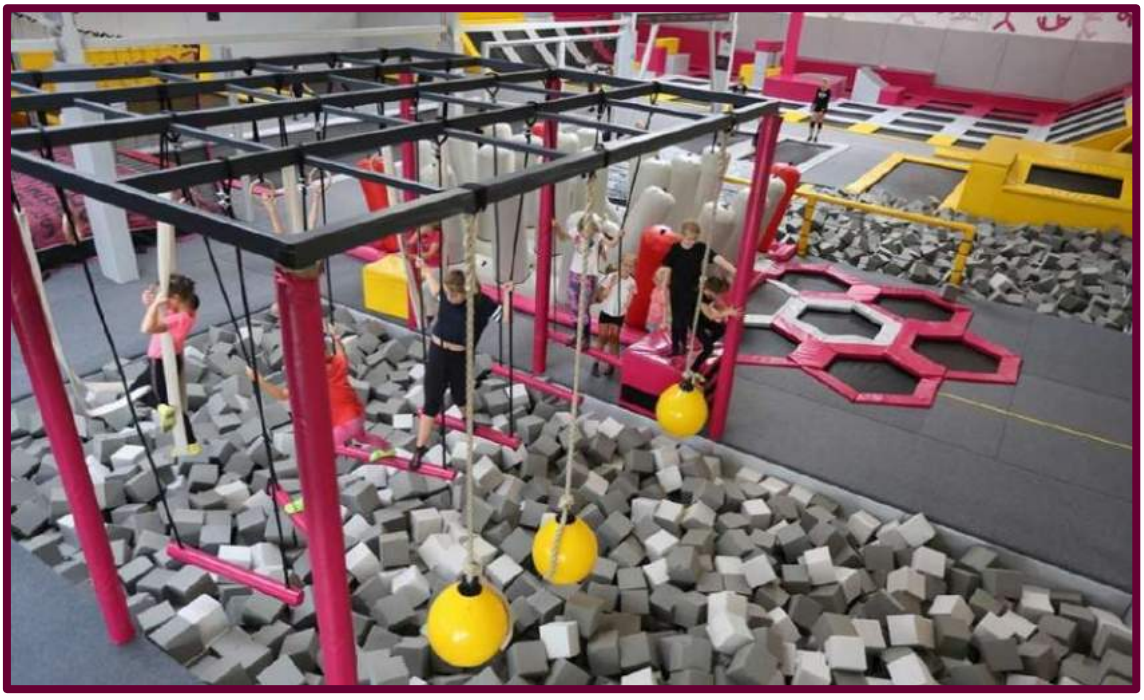


Photo: Parkparabola.pl, private collection

70. The spiral is ruling here

There is perhaps no one who, when tasked with drawing a spiral, would not sketch it more or less accurately. The form, which occurs every day in nature, is defined by the wiki glossary as a flat curve, which, going round a point repeatedly, moves away from it.
A slightly completely different definition of a spiral can be found in "Cafe Spirala" in Bielsko-Biała at Przechód 1. Here, a helix has a specific taste and an old school sound. Here you can eat confectionery wrapped in the shape of a spiral and listen to music from vinyl records, on which the audio track is recorded in the shape of a spiral. A mathematical trivia is that if you cut such a record along the slits where the sound is written, the vinyl would be over half a kilometre long.

Spirala Cafe, Bielsko-Biała, 1 Przechód Street.

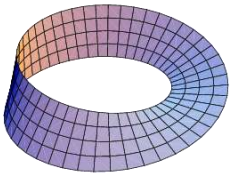
Photo: Pixabay, adamkontor

71. Geometry from glass and steal

Thirty years ago the draft of the Cavatina complex, which was built in Bielsko-Biała, would have ended up in the designer's desk drawer as an impossibility. Abstract curves and realms, the measurement of which requires complicated mathematical formulas, until recently inspired only the authors of SF novels. The building is unique not only because of its futuristic shape, but also because of its glass elevation, under which the glass skeleton of regular triangles is clearly recognisable.
The building serves two purposes. It houses offices and a large concert hall, which primarily owes its excellent acoustics to its futuristic shape.

Cavatina Hall, Bielsko-Biała, 2 Dworkowa Street

Photo: Magdalena Ciesielska, private collection



72. Climbing through diversity

"Play on this two-dimensional topological dense multiform" is how the invitation to climb the object located on the playground in Szczyrk is supposed to sound. This is the full name of the mathematical surface popularly known as the Möbius strip. The Möbius strip is an unique space with only one side, unlike the ones we come across every day. Anyone can smoothly make one on their own. It is only necessary to connect the shorter sides of a narrow strip of paper by turning one of the ends by 180 degrees.

In Szczyrk, on Wrzosowa Street, there is also one of the biggest hills (driveways). It amounts to 17%, which means that on the distance of 100 m the height increases by 17 m. This is equivalent to an elevation angle of about 9.6^{O}.

Möbiusa Ribbon on a playground, Szczyrk, Promenade over Żylica, (access from Bławatków Street)

Photo: Magdalena Ciesielska, private collection

73. Wheels of time

God, eternity, balance, accuracy, spirituality - these are just some of the concepts symbolised by the wheel. In Cieszyn, which lies on the border with the Czech Republic, the circle is an open-air invitation to visit and spend some free time.
In fact, they are cylinders inside which comfortable wooden benches have been put. Set along the river Olza, they are part of the Open Air Museum. Illuminated at night, they create a beautiful symmetric play of lights reflecting in the waters of the river.
On the exterior of each roller, there are plaques with the most important historical events of the city, also written in Braille.

Wheels of Time in the Open Air Museum, Cieszyn

Photo: Magdalena Ciesielska, private collection

74. Fiery triangles

Fire is a continuous process of movement. It is almost impossible to capture its very essence in a still object. And yet the Fire Museum in Żory, created from irregular triangles covered with copper, creates a wonderful symbol of the element that has always been a source of fascination for man.
The triangles of the museum's façade connect with each other at different angles, creating a chaotic, yet coherent mass.
The copper sheeting of the building makes the walls seem to vibrate and shake both during the day and after dark, adding to the fire-like effect.

Fire Museum, Żory, 3 Katowicka Street

Photo: Wikipedia.pl, Kamil Czaiński

75. Corn from Chicago

Five semi-detached houses in Katowice's Tysiąclecia residential area have been nicknamed "Corns". Their rounded balconies give them a characteristic shape resembling cobs. Where others see corn, a mathematician will easily spot waltzes. In fact, Katowice's buildings are some of the few dwellings in Poland built on an octagonal plan. Eight geometric blocks rise to a height of 87 metres, and the two lower blocks are 56 metres high. Their authors were inspired by the buildings of Marina City in Chicago.

Corns, Katowice, Tysiąclecia Estate

Photo: Wikipedia.pl, Sojomail

76. The praise of geometry

Among the many activities available in the Silesian Park in Chorzów, located on over 500 hectares, it is easy to miss the mathematical implications of this place. And there are really a lot of them here. The dome of the Silesian Planetarium makes a big impression. It has a spherical shape encircled by a cylinder, and as the largest object for this purpose in Poland, it towers over its neighbourhood. The lens itself, installed in the planetarium, weighs 2 tons, and its height is 5 metres. Other mathematical inspirations can be seen during the cable car ride. Worth noting are the geometric shapes of the flowerbeds, the rectangular geometry of the Japanese garden and the circular stadium.

Silesian Planetarium in Silesian Park, Chorzów, 2 Różana Avenue

Photo: Wikipedia.pl, Fallaner

77. Zawiercie reaches excellence

At times, geometric architectural structures are seen from a distance. Sometimes you have to look carefully at a fragment of a building in quest of them. In Zawiercie you have to look carefully under your feet. It is there, on the John Paul II Square, that a trail was created, which together with fountains creates the Fibonacci spiral.
In Zawiercie, the Fibonacci Spiral is the work of human hands. It also commonly occurs in nature, allowing plants to achieve the perfect arrangement of flakes and leaves. The apparently simple relation called the Fibonacci sequence can also be observed in the shape of galaxies. Everything indicates that by designing the John Paul II Square in Zawiercie, the model of excellence has been achieved.

Hulist Fountain Zawiercie, Jana Pawła II Square, 400 Księdza Kardynała Stefana Wyszyńskiego Street

Photo: Foto-flesz.com.pl, Jerzy Janus

78. Balancing infinity

Infinity is one of the most abstract concept that students learn. The Sculpture by Jerzy Kędziora, which the artist claims balances between minus and plus infinity, is not only an eminent work of art, but also a mathematical metaphor.
The sculpture "Infinity", is one of the so-called balancing sculptures. Hanging above the ground, they not only seem to be in constant motion. They are indeed perpetually moving. The inhabitants of Olsztyn learnt how delicate their balance can be a few years ago, when the sculpture was destroyed during one of the windstorms and it took a few months for it to be refurbished so that it could once again decorate the Olsztyn market square.

Sculpture “Infinity”, Market Square in Olsztyn

Photo: Wikipedia.pl, Adrian Tync

79. Not only Jasna Góra

In Częstochowa, the Jasna Góra Sanctuary is a must-see tourist attraction. A few hundred years after the Jasna Góra Abbey, a church was built in the city, which is also likely to become a prominent landmark of Częstochowa.
Looking at St Brother Albert's Church from the perspective, we notice above all its towering and arched pillars rising to the sky. The soft, delicate mass with no right angles seems to ascend to the sky.

St. Brother Albert Church,
Częstochowa, 34 Narcyzowa Street

Photo: Wikipedia.pl, Magnus Manske

From the ground, it is almost impossible to see the perfect proportions of the church, built on an octagonal plan arranged in a circle.

St. Brother Albert Church,
Częstochowa, 34 Narcyzowa Street

Photo: Igor Snopek, Fundacja Bęc Zmiana, www.beczmiana.pl

The photograph is from the research project and publication 'Architecture of the 7th Day'.

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ROUTE NO. IX

What are the Hugonotes?

The route covers the Lower Silesian Voivodeship and part of Opolskie Voivodeship

- **Opole**
- **Wrocław**
- **Wałbrzych**
- **Piątek**
- **Łowicz**
- **Łódź**
- **Poddębice**
- **Kalisz**
- **Koło**

The mapa of the south-easter Poland

Drawing by Magdalena Ciesielska

based on a map from the typhlological Atlas of Polish
(Main Office of Geodesy and Cartography, Main Board of PZN)

80. In praise of simplicity

Mathematical curves, surfaces and geometric forms often inspire architects. Their outcome can sometimes be fantastic solids with complex structures. However, it sometimes happens that architects reach for the simplest forms and that's how they achieve a phenomenal effect.
This is what happened in the case of St. Borromeo Church in Opole. It is hard to find a simpler inspiration than a cylinder. The temple on Chabrów Street is shaped like half of this solid. What gives it its lightness and unique character are the rainbow-like arrangements of colorful stained glass windows placed under the oval vault.

St. Borromeo Church, Opole, Chabrów Street

Photo: Magdalena Ciesielska, private collection

“Architecture is geometry used in construction”
Hugo Steinhaus

81. Mathematics and music

During the 2nd International Marble Sculpture Plein Air in 2008, 8 sculptures were made, with the song as the main theme. Two of them are likely to appeal to math enthusiasts, as geometry inspired their creation.
The Möbius ribbon became the initial inspiration for the “Violin” sculpture. It depicts the transformation from musical notation to music, according to author Andrzej Kosovsky.
When sculpting "Digital Rapodia," Radoslav Sultov modelled it on one of the five Platonic solids - the cube. Each of the six square walls decreases in size, rotates and moves inward, creating a spiral staircase leading to the interior of the solid.

Violin Sculptures and Digital Rhapsody, Opole, square in front of the Opole Philharmonic Hall, Krakowska Street

Photo: the City of Opole’s own collection, opole.pl

"Mathematics is universal: there is nothing that is foreign to it." **Hugo Steinhaus**

82. Socrates as from a fayri tale

Bielarska Island is a peculiar place in Wroclaw. Despite its small area, there are many attractions on it, which will certainly appeal especially to children. Lovers of the queen of sciences will also find something for themselves.
On the playground located on the island, children can climb up constructions built on the model of polyhedrons. However, the biggest attraction of the island is the statue of the Greek philosopher Socrates, whose teachings are the foundation of the didactics of mathematics. The sculpture of the father of philosophy is fashioned after a fairy tale character.

Socrates Sculpture, Wrocław, Bielarska Island

Photo: Magdalena Ciesielska, private collection

“Philo’s love for Sophia - Philosophy.”
Hugo Steinhaus

83. Mathematics in art

Before we start noticing the mathematical connotations of the "Nave" sculpture on Daliowa Island in Wrocław, we are thrown by its designer look. Its reduced version could adorn luxury apartments. The 35 steel arches reflect in their polished steel spans the landscape that changes with each season.
The spectacular sculpture is incredibly impressive.
From a mathematical point of view, it is a spatial depiction of curves that could be successfully described by a proper sequence of function formulas. The blend of artistic expression and mathematical precision has resulted in a remarkable, eye-catching sculpture.

Nave Sculpture, Wrocław, Daliowa Island

1st and 2nd photo: Magdalena Ciesielska, private collection

**“There is only one thing I like about this country:
to stay …”**
Hugo Steinhaus

84. Football Fountain

Without mathematics, there would be no modern football. This popular sport, like others, began to use the Queen of Science to accurately calculate players' performance statistics. Everything to improve athletic performance.
In Wroclaw, it was decided to use football to make the fountain on the green area at the intersection of Szewska and Wita Stwosza Streets more attractive. The mathematician sees balls with a dodecahedron edge, but a football fan will also see how they are turned into football balls. The combination of mathematics and sports was very successful in Wroclaw.

Football Fountain, Wrocław, corner of Szewska Street and Wita Stwosza Street

Photo: Magdalena Ciesielska, private collection

“The joke should not be aimed, but hit”
Hugo Steinhaus

85. Hugonotes author

The bust of Hugo Steinhaus was placed in the Gallery of Famous Wrocław Citizens, in the Town Hall of the Old Town Hall in 2013. During the ceremony of unveiling the sculpture, the students of the genius mathematician recalled that he cared about the correctness of mathematical proofs as well as compliance with the rules of the Polish language. They also remembered him as the creator of aphorisms and anecdotes called Hugonotes.
Not only do his students remember the professor. His grave at the Holy Family Parish Cemetery could have been liquidated due to the lack of extension. The fundraiser was organized by the Mathematical Institute of the University of Wrocław, and the necessary amount, thanks to the generosity of the inhabitants of Wrocław, was collected in one day.

Bust of Hugo Steinhaus,
Gallery of Famous Wrocław Citizens in the City Hall

Photo: Magdalena Ciesielska, private collection

“Between spirit and matter is mediated by mathematics.”
Hugo Steinhaus

86. Hour of zeros and ones

On the mathematical trail leading through Wroclaw, the Wroclaw University of Technology should not be overlooked. It is on its grounds that you will find a classical sculpture in the shape of a Möbius ribbon and a totally non-classical binary clock.
The clock was designed by students from the Technical University's Scientific Circle, and it took them a couple of months to complete the project. The facade of the university resembles a piece of paper with Braille dots, due to the circular shape of the windows. Visually, the clock is three lines of illuminated windows displaying the hour, minute and second. There are six windows in each row. Checking the time, even knowing the principle of a binary clock, requires skill and basic math skills. But it's definitely worth trying your luck especially since the polytechnic building on which the Great Binary Clock is located has been nominated as one of the 7 wonders of the Capital of Lower Silesia.

Möbius ribbon sculpture,
Wrocław University of Technology, Building C-13,
Wybrzeże Stanisława Wyspiańskiego 23

Photo: Patrycja Dzwonkowska, radiowroclaw.pl

The Great Binary Clock, Wrocław University of Technology, Building C-13, Wybrzeże Stanisława Wyspiańskiego 23

1st and 2nd photo: Magdalena Ciesielska, private collection

"Why do people learn math? To teach math to others."
Hugo Steinhaus

87. Nice egg

Traffic circles can be found in every city in Poland, on bypasses and even in villages. The smallest, which was built in Wadowice, is only 150 centimetres in diameter. Wroclaw is the only city in Poland to have an elliptical-shaped traffic circle. Inside the Ronald Reagan traffic circle, located on Grunwaldzki Square, is a traffic junction whose roofing is also shaped like an ellipse.

Ronald Reagan Roundabout, Wrocław, Grunwaldzki Square

Photo: Wikipedia.pl, Olgierd Rudak

"There should be warning signs at the corners of life's road:
Do not speed 24 hours a day"
Hugo Steinhaus

88. Mathematical dwarf

Zielona Góra has its Bachusiki, and Wrocław can be visited along the trail of dwarves embellishing the city. One of them has been placed on the grass in front of the Faculty of Mathematics at Wroclaw University. The place is not random, as the dwarf, designed by Beata Zwolanska-Holod, is a mathematician.
The figure, cast in bronze, is nearly 40 centimeters high. The gnome is leaning over books on the covers of which you can read the names of subjects like algebra, analysis or geometry. It is worth taking a closer look at him and glancing at the notebook he is holding in his hands. Written in it is Euler's equation - the most beautiful equation of mathematics $e^{i\pi} + 1=0$.

Dwarf “Mathematician”, Faculty of Mathematics UWr

Photo: Magdalena Ciesielska, private collection

“It is easy from the world of reality to go into the forest of mathematics, but few only know how to return.”
Hugo Steinhaus

89. In tribute to cryptologists

Cyphers fascinate people, and those who can break them arouse admiration. The best of them become famous and remain in people's memory for a long time. Undoubtedly, among them is the team of Polish cryptologists who broke the Enigma cypher. In Wroclaw, their accomplishments were honored by naming the Zespół Szkół Teleinformatycznych I Elektronicznych after the Polish Enigma Breakers. On the second floor of the school, there is a monument representing the three cryptologists and a plaque, which is a tribute by the school’s students to the "Great Polish Mathematicians and Cryptologists."

Monument to Cryptologists at ZSTiE,
Wrocław, 21 Gen. Józefa Haukego-Bosaka Street

Photo: matematyka.wroc.pl, private collection

"A joke is a cypher; it selects addressees automatically and without mistakes." **Hugo Steinhaus**

90. Technology for the youngest

Learning through play is the best way to pass on knowledge to children. ExploraPark in Wałbrzych is a place where the youngest learn technology and mathematics by independently performing experiments and drawing conclusions from them.
ExploraPark also features a set of interactive exhibitions created by specialists from the Competence Research Institute. On them, you can learn, amongst other things, the principle of the Chinese abacus or twin geometry.

„ExploraPark" Science and Tchnology Park, Wałbrzych, 66 Moniuszki Street

1st photo: ExploraPark, private collection
2nd photo: Magdalena Ciesielska, private collection

"No science strengthens faith in the power of the human mind as much as mathematics."
Hugo Steinhaus

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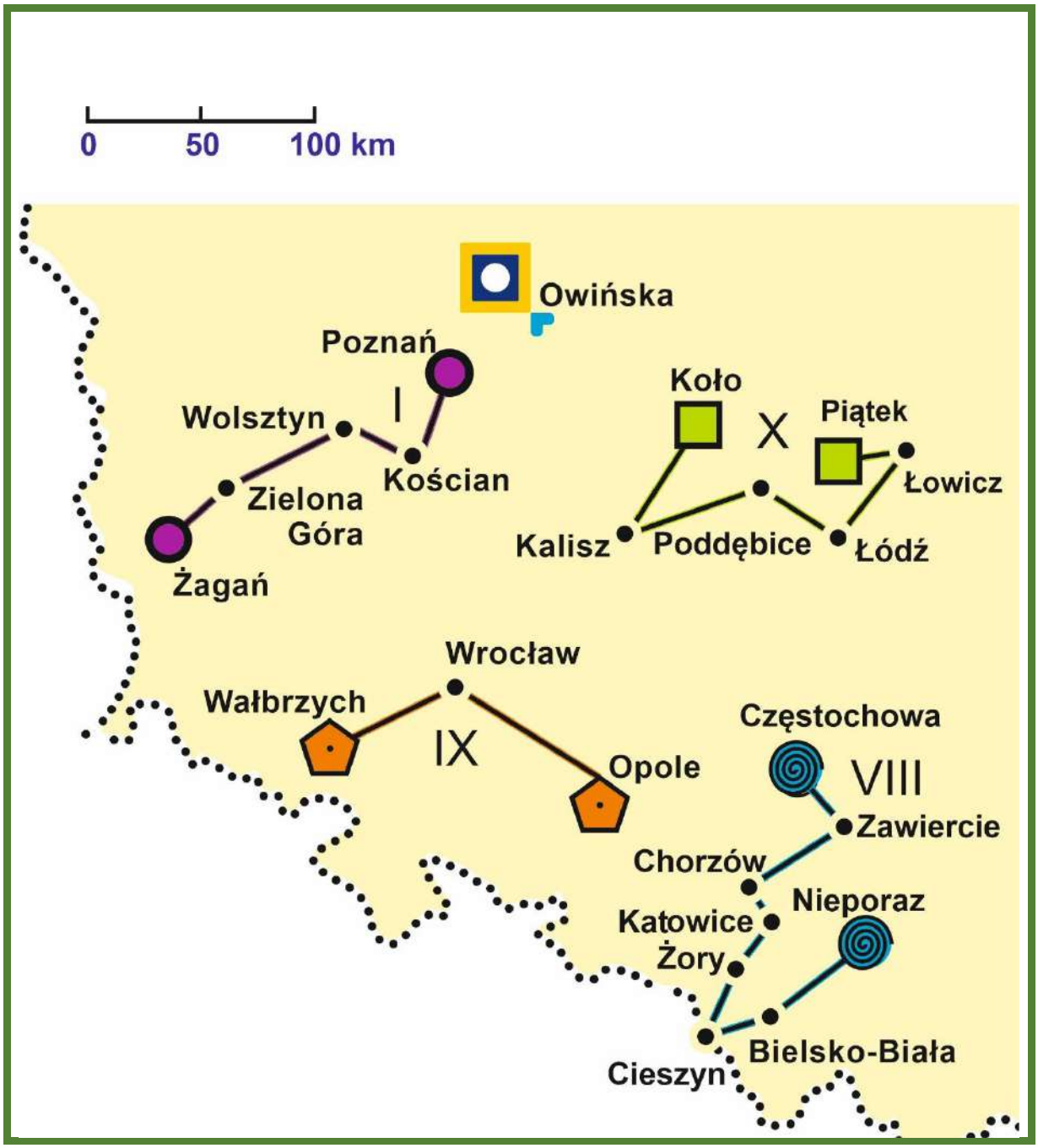
ROUTE NO. X

Adventure squared

The route covers Łódzkie Voivodeship and part of Greater Poland Voivodeship Wielkopolskiego:

- **Piątek**
- **Łowicz**
- **Łódź**
- **Poddębice**
- **Kalisz**
- **Koło**

The map of southwest Poland



Drawing by Magdalena Ciesielska

based on a map from the typhlological Atlas of Polish
(Main Office of Geodesy and Cartography, Main Board of PZN)

91. Where is the middle?

Determining the centre of a circle, square or triangle is not very complicated and can be done by a primary school pupil.
The problem arises when the shape of the figure is unusual. Very irregular. According to the definition, the geometric centre of Poland is the point which is the centre-point of the geometric figure of the shape and size of the administrative borders of the country.
It is equivalent to the intuitive meaning of the concept of the centre of a given area. One of the centres of Poland is located in Piątek municipality. It was determined in 1966. Currently, some geodesists postulate moving it by 17 km to the village of Nowa Wieś. Anyway, being in the area you can visit two midpoints of our country.

Geometric Centre of Poland, Piątek, Rynek

Photo 1. Magdalena Ciesielska,

Photo 2. Wikipedia.pl, Merlin

92. One side too little

The classic town square was set on a square or rectangular plan. That is why standing on the market square in Łowicz we can start to feel a bit confused. It is one of the three market squares in Poland and very few in the world which have a triangular shape. In 2009, on the initiative of students from the local high school, the market in Łowicz was named the Mathematical Market. It is there that outdoor planimetry lessons are often conducted. It is also recommended to visit Łowicz Museum, where you can find the regional paper cut-outs full of symmetry and spatial fractal-like Łowicz spiders.

Mathematical Market, Łowicz, New Market

Photo: Pijarskie Szkoły Królowej Pokoju w Łowiczu, private collection

93. A restaurant squared

When we get hungry during our sightseeing we can visit a restaurant with mathematical connotations. In Łódź, at 180 Wólczańska Street (or in the Tulipan Shopping Centre) there is a restaurant called "Do kwadratu" (To the Square) whose speciality is pizza. In the square shape, of course.

Menu of the „Do kwadratu” Restaurant, Łódź, 180 Wólczańska Street




Photo: facebook.com/DoKwadratuRestauracja

94. Play under the pyramids

Fun at the Aquapark is not exactly favourable for mathematical contemplation. However, it is worth knowing that even there we can find its very explicit traces.
Spirals, prisms and pyramids are structures that can be easily noticed in the Fala Aquapark in Łódź. And for those who love thrills, we recommend going down a 50-metre slide with an angle of almost 38 degrees.

“Fala” Aquapark, Łódź

Photo: www.lodz.pl

95. Silence, peace and geometry

The Senses Gardens in Poddębice are an ideal place for the midday relaxation and geometric treasures seeking, hidden there. The garden is divided into 5 sectors, from which, each enables one to explore the world using a different sense. There are spheres of hearing, touch, smell, sight and spatial orientation. Among the geometric objects that can be seen in the garden, there are sinusoidal benches, chords of a circle, on which the music range can be performed, as well as a play for the youngest with the colourful squares. Additionally, the facilities in the park are described in Braille writing.

The Senses Garden, Poddębice

Photo: Magdalena Ciesielska, private collection

96. The church of patterns on a sheet

A hyperbolic paraboloid is a surface that is formed when a parabola is shifted along another parabola. The complicated definition resulted in the extraordinary construction of the Divine Mercy Shrine in Kalisz. This is a giant homogenous building, meaning that it was built without any supporters. Its co-author said, many years after the end of the construction phase, that the decision to build was an act of enormous courage. This is due to the shapes of the block which needed precise calculation. In 1958, when the decision about the church's shape was made, there were no computers, so every single calculation was done by a man. Interestingly, there were not many courageous and capable mathematicians, eager to run such. The ones, who covered them by hand on a piece of paper, were Edward Otto and Adam Empacher. Thanks to them, we can admire this outstanding meeting of architecture with mathematics.

The Divine Mercy Shrine,
Kalisz, 54 Adama Asnyka Street

Photo: Magdalena Ciesielska, private collection

97. Vibrting string model

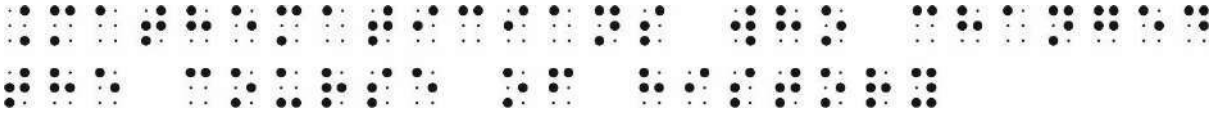
The way in which Janusz Kapusta observed a. Spatial form in two inscribed squares, will always remain his secret. However, in 1985, using a paper sheet, he made a model of a block, which he later called “K-drone”. The name derives from the Greek language. “Drone” means the “wall”, while “K” is the 11th letter of the alphabet. The surface of the K-drone is made of the rhomb with attached squared triangles and the “K-drone” base, which together form an eleven-wall. The most interesting feature of the K-drone is that two K-drones put together form a cube.

The K-dron, Koło, 21/23 Sienkiewicza Street

Photo: Beata Ciesielska, private collection

ROUTE NO. XI

Mathematicians who changed the course of history



The route covers the Kuyavian-Pomeranian Voivodeship:

- **Bydgoszcz**
- **Toruń**

Map of northwest Polish

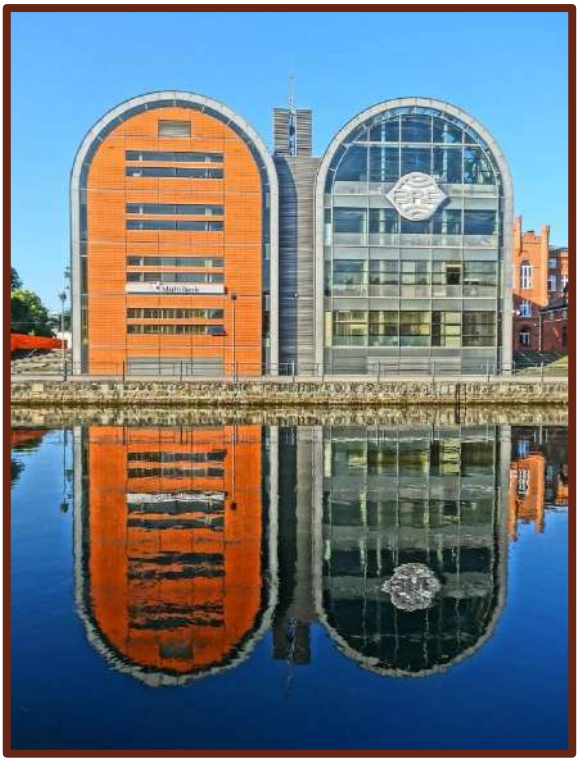
Drawing by Magdalena Ciesielska

based on a map from the typhlological Atlas of Polish
(Main Office of Geodesy and Cartography, Main Board of PZN)

98. Mathematics on the Brda River

Many mathematical inspirations can be found in the buildings located on the Brda River which flows through Bydgoszcz. Here you can see the granaries built in the half-timbered technique, i.e. the front of the building is made of squares and triangles. A few hundred meters away rises a modern building of MBank built on the model of the granaries. The tall glazed construction looks like a rectangular cube covered with half of a cylinder.

MBank building and Old Granaries, view from Stary Port Street, Bydgoszcz, Grodzka Street



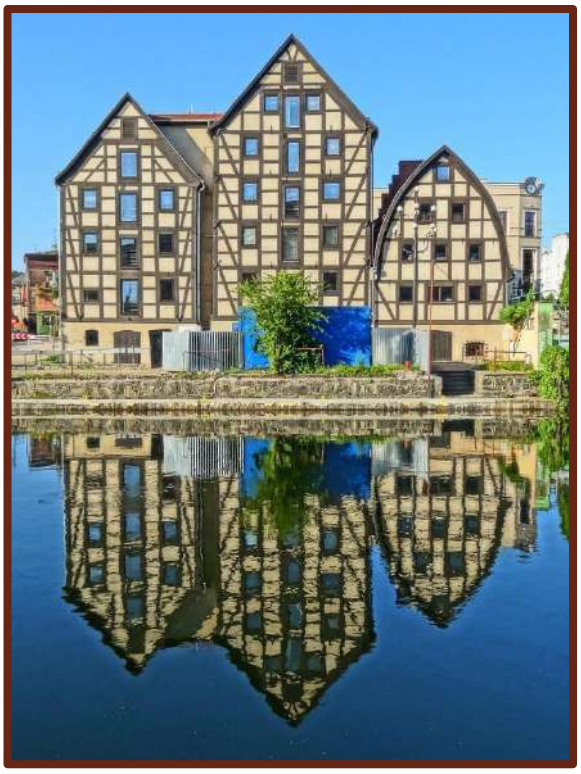


Photo: Wikimedia.pl, Pit1233

99. The City Remembers a Hero

Marian Rejewski, also called "Bydgoszcz's Copernicus", one of the three cryptologists who broke the code of the enigma, was born and lived in Bydgoszcz after the war. After the war, which also thanks to him and his achievements, lasted shorter and caused fewer deaths. There are many places in the capital of the Kuyavian-Pomeranian region that commemorates this fact. On the building at 6 Wileñska Street, where the eminent mathematician was born and lived, there are plaques commemorating the Bydgoszcz citizen's achievements.

Place of birth of Marian Rejewski, Bydgoszcz, 6 Wileńska Street

Photo: wikipedia.pl, Pit 1233

After the war he occupied a building at 10 Dworcowa St. Plaques dedicated to the outstanding cryptologist are located at 10 Gdanska St., where the mathematician lived in 1962-69.

The side of that building is decorated with a large mural paying tribute to Rejewski. You can see his portrait and a distinctive notation of the Enigma code. The distinguished part of the cypher letters forms the inscription: "Marian Rejewski". Another mural is located at 37 Garbary Street.

Mural, 10 Gdańska Street, Bydgoszcz

Photo: Malgorzata Bohuszewicz, private collection

At the corner of 37 Gdańska Street and Śniadeckich Street there is a bench with a statue of the cryptologist.

Jerzy Różycki's Bench, Bydgoszcz, 37 Gdańska Street

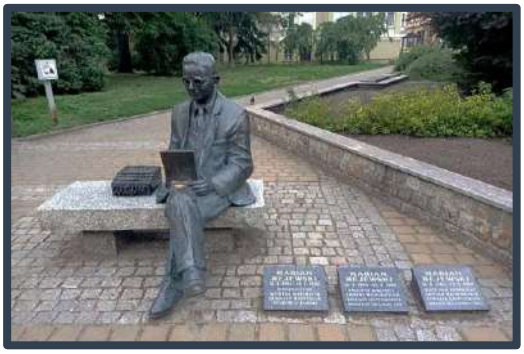


Photo: Beata Ciesielska, private collection

And on the wall of the 1st High School at 9 Wolności Square a memorial plaque dedicated to the eminent graduate was revealed.

100. Astronomical Mosaic

Toruń is the hometown of Nicolaus Copernicus, a person of great knowledge in various fields. Although best known as an astronomer, he was also a mathematician.
The mosaic on the front of the assembly hall of Nicolaus Copernicus University in Toruń is a tribute to the great astronomer. It depicts a sun clock with Copernicus' portrait and colorful planets forming a combination of circles and rings.

Stefan Knapp's mosaic, Toruń, 17 Jurina Gagarina Street

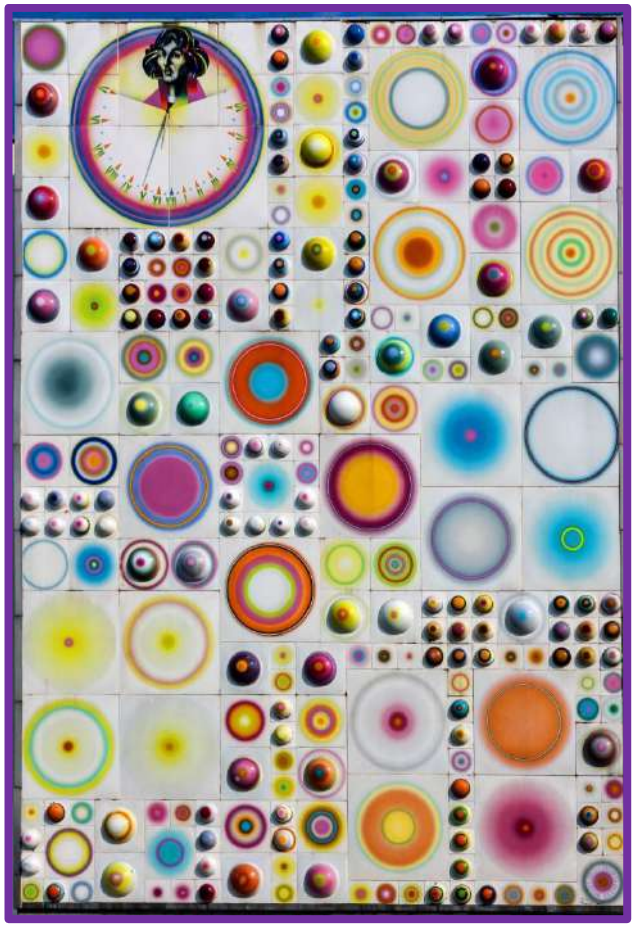


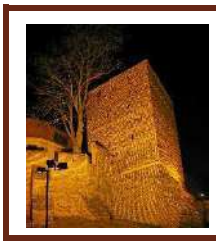
Photo: Wikipedia.pl, Pko

101. Heliocentric fountain

In Planty Park in Toruń there is an extraordinary tourist attraction. The fountain inspired by the heliocentric system for several years is one of the regular points visited by tourists and residents of Toruń.
The fountain consists of 113 jets, and instead of the water surface has a slab of marble with an engraved Latin text and a schematic diagram of the solar system. The central stream symbolizing the sun emits a jet of water to a height of 5 meters, and is placed on the orbits of the planets at 4.5 meters.
The real show begins after dark, when the electro-controlled fountain is illuminated in different colors, and streams of water are released to the rhythm of music.

Cosmopolis Fountain, Toruń, 1a Staromiejska Moat

Photo: Wikipedia.pl, Zorro2212



102. The Leaning Tower of Toruń

Residents of Pisa have their leaning tower, and people from Toruń have their tower, which leans over the city walls. The tower, although lower than the more famous tower in Italy, has a slope of over 5 degrees, which is greater than the monument from Pisa.

The tower's deviation from the vertical is caused by the unstable ground, although it is also covered with many legends.

As you can see, not every double-wall angle has 90°.

Leaning Tower, Toruń, 1 Pod Krzywą Wieżą Street

Photo: Wikipedia.pl, Staszek99

103. Copernicus - physician, diplomat, mathematician

Nicolaus Copernicus stopped the sun and moved the earth. This is the first connotation that comes to mind when we hear the name of this great astronomer. He treated mathematics as a tool for proving his astronomical assumptions, and he himself tried not only to draw on the available knowledge but also to expand his mathematical horizons.
Nicolaus Copernicus is the author of the work "Trigonometry", in which he discusses, among other things, the tendons of a circle and plane and spherical triangles. Therefore, every math lover visiting Toruń should see both the astronomer and mathematician's monument in the Old Town Market Square and the dedicated chapel with his bust in the Cathedral Basilica at 6 Nicolaus Copernicus Street. It is worth knowing that the author of the heliocentric theory was also a diplomat, doctor, a clergyman and a doctor of Canon Law.

The Church of St. John and the Baptist and St. John the Evangelist, Toruń, 6 Mikołaja Kopernika Street
The Copernicus Wall

Photo: Wikipedia.pl, Jolanta Dyr., Upper photo: wikipedia.pl, pudelek

Bust and epitaph of Copernicus

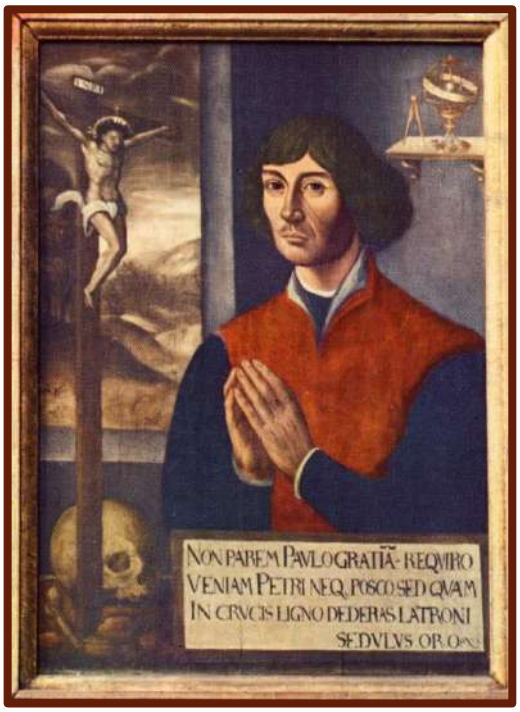


Photo 1. Wikipedia.pl, Wojciech Dittwald,
Photo 2. public domain

Monument to Copernicus / Old Town Square

Photo: Pixabay.pl, Mateusz_foto,

104. Copernicus Museum

He held back the sun, moved the earth, and was born in Toruń. Today, in the house where the man who created the heliocentric theory was born and grew up, there is a museum dedicated to the outstanding astronomer. The unusual combination of the historic building and the latest technology allows everyone to learn about the life and accomplishments of the astronomer from Toruń.
The exhibition is fully interactive and its content can be extended through a multimedia app that can be installed on your phone. In addition, holograms, enhanced reality and 4D cinema await visitors.

The Copernicus House in Toruń, 15/17 Kopernika Street

Photo: Wikipedia.pl, Stephen McCluskey

105. The Mill of Science in Toruń

Six floors and 5 thousand square meters of space in the renovated building of the historic Richter Mill is taken up by the Science Centre in Toruń. In this unique place, using the latest achievements of technology, you can get to know the laws of nature, experiment and see the largest Foucault's oscillator in Poland.
Mathematicians will certainly be most impressed by the exhibition on circles and rotary motion. All parts of the exhibition are highly interactive and fun to learn.

The Mill of Knowledge Modernity Center,
Toruń, 5 Władysława Łokietka Street

Photo: Wikipedia.pl, CNMW

Mathematical streets

Mathematics is ubiquitous and very important, which is why they used terminology from the Queen of Sciences to name streets in Poland.

Pitagoras Street in Niemcz

Foto: Magdalena Ciesielska, zbiory własne

The name of the mathematical street	Where is located
Algebraiczna (eng. **Algebraic**)	Białystok
Calowa (eng. **Integral**)	Warszawa
Całkowa (eng. **Integer**)	Nowy Sącz
Cyfrowa (eng. **Numerical**)	Szczecin
Cyrklowa (eng. **Circular**)	Warszawa
Dodatnia (eng. **Positive**)	Łódź
Dwusieczna (eng. **Bilateral**)	Warszawa

Dzielna (eng. **Divisive**)	Warszawa, Kraków
Foremna (eng. **Regular**)	Łódź
Funkcyjna (eng. **Functional**)	Białystok
Geometryczna (eng. **Geometric**)	Warszawa, Grodzisk
Hektarowa (eng. **Hectare**)	Warszawa, Częstochowa, Łódź, Jaskrów
Hektary (eng. **Hectares**)	Kraków, Podwarpie
Kąt (eng. **Angle**)	Kraków
Kątowa (eng. **Angular**)	Kraków
Kątna (eng. **Angular**)	Łódź
Kołowa (eng. **Circular**)	Warszawa
Krzywa (eng. **Curve**)	Wrocław, Kraków
Kwadratowa (eng. **Square**)	Józefosław
Liczydło (eng. **Abacus**)	Warszawa
Liniowa (eng. **Linear**)	Białystok
Logiczna (eng. **Logical**)	Wrocław
Łamana (eng. **Broken**)	Kraków, Radom
Matematyczna (eng. **Mathematical**)	Białystok
Metryczna (eng. **Metric**)	Warszawa
Milionowa (eng. **Millionaire**)	Łódź
Mnożna (eng. **Multiplicative**)	Białystok
Naturalna (eng. **Natural**)	Łódź
Niewiadoma (eng. **Unknown**)	Ostrowiec Świętokrzyski
Obwodowa (eng. **Peripheral**)	Warszawa
Odcinek (eng. **Section**)	Wrocław
Okrąg (eng. **Circumference**)	Kraków
Okrągła (eng. **Circular**)	Warszawa
Okręgowa (eng. **Circular**)	Łódź

Owalna (eng. **Oval**)	Warszawa
Parzysta (eng. **Even**)	Warszawa
Pierwiastkowa (eng. **Elemental**)	Białystok
Podobna (eng. **Similar**)	Warszawa
Prosta (eng. **Straight**)	Warszawa, Kraków, Kicin
Prostokątna (eng. **Rectangular**)	Gdynia
Prostopadła (eng. **Perpendicular**)	Tarnów
Przekątna (eng. **Diagonal**)	Kraków
Przestrzenna (eng. **Spatial**)	Łódź
Rozwarta (eng. **Open**)	Toruń
Równoległa (eng. **Parallel**)	Warszawa
Setna (eng. **Hundred**)	Wrocław, Łódź, Dębno
Sieczna (eng. **Incisive**)	Warszawa
Spiralna (eng. **Spiral**)	Warszawa, Hajnówka
Średnia (eng. **Medium**)	Poznań, Świętochłowice
Trapez (eng. **Trapezoid**)	Warszawa
Trapezowa (eng. **Trapezoid**)	Dęblin
Trójkąt (eng. **Triangle**)	Łazy
Trójkątna (eng. **Triangular**)	Wrocław
Ułamkowa (eng. **Fractional**)	Białystok
Wielokątna (eng. **Polygonal**)	Poznań

Street name of the Mathematician	**Where is located**
Archimedesa (eng. **Archimedes**)	Warszawa, Kędzierzyn-Koźle

Banacha (Stefana)	Warszawa, Wrocław, Kraków, Radom, Nowy Sącz
Borsuka (Karola)	Warszawa
Hipokratesa (eng. **Hippocrates**)	Łomża
Kartezjusza (eng. **Descartes**)	Warszawa
Kopernika (Mikołaja) (eng. **Nicolaus Copernicus**)	Toruń, Wrocław, Kraków
Kuratowskiego (Kazimierza)	Warszawa
Leibniza (Gottfrieda)	Warszawa
Matematyków Krakowskich (eng. **Cracow mathematicians**)	Kraków
Pitagorasa (eng. **Pythagoras**)	Warszawa, Niemcz
Rejewskiego	Poznań, Warszawa
Różyckiego (Jerzego)	Poznań
Sierpińskiego (Wacława)	Warszawa , Koszalin, Konin, Zielona Góra, Ruda Śląska
Steinhausa (Hugona)	Warszawa, Wrocław
Talesa z Miletu (eng. **Thales of Miletus**)	Łomża
Zygalskiego	Poznań

Other mathematical names	**Where is located**
Rondo Pitagorasa (eng. **Pythagoras Roundabout**)	Starogard Gdański
Rondo Różyckiego (eng. **Różycki Roundabout**)	Wyszków
Aleja Krzywa (eng. **Crooked Avenue**)	Dąbcze

Klein bottle – one-sided surface, the container being its three-dimensional projection is designed to hold liquids. A moderately filled bottle can be placed with its mouth down without pouring out the contents, provided that it is turned in the right direction. A Klein bottle can also be constructed by bonding the edges of two Möbius bands together.

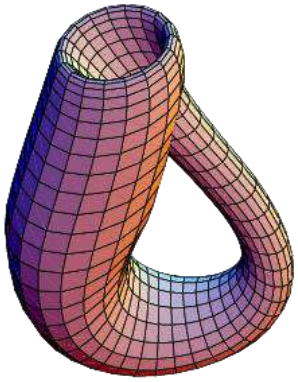


Illustration: Wikipedia.pl, Lukas Hozda

Helkoid – screw surface, drill surface, spiral staircase, often spiral staircases to lookout towers.

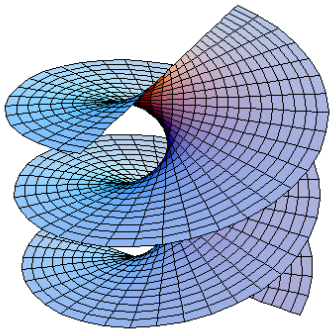


Illustration: Wikipedia.pl

Hyperbole – the graph of a function defined by the formula $y = \frac{a}{x}$, consists of two symmetrical curves.

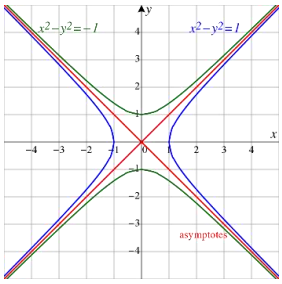


Illustration: Wikipedia, Rubber Duck

Monolayer hyperboloid – a surface formed by the rotation of a hyperbola about its axis of symmetry (disjoint from it).

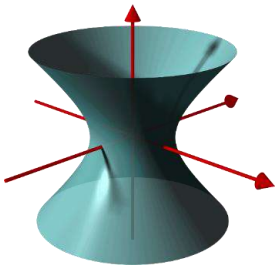


Illustration: Wikipedia, Lars H. Rohwedder

Bilayer hyperboloid – the area produced by rotating a hyperbola around the axis of hyperbola symmetry passing through both points of the hyperbola.

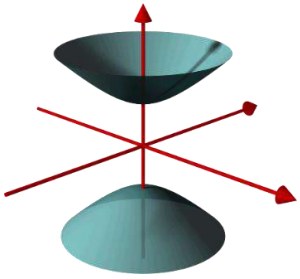


Illustration: Wikipedia, Lars H. Rohwedder

K-drone – a geometrical solid with 11 faces; the base is a square. A k-dron is made up of a k-dron surface, which is a rhombus with right-angle triangles and k-dron bases appended. Two k-drones put together give a cube.

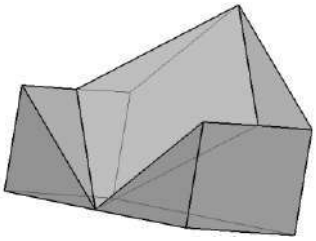


Illustration: Wikipedia.pl, Olaf

Parabola – graph of the quadratic function defined by the formula $y = ax^2$. The shape resembles a smile or a sad face.

Illustration: Wikipedia, -xfi-

Hyperbolic paraboloid – the area of the second degree created by moving a parabola along another parabola.
The parabolas must be in planes that are perpendicular to each other, and their arms must point in opposing directions.

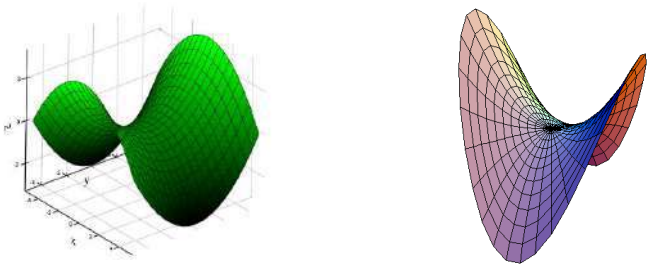
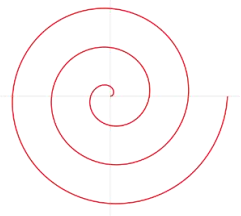


Illustration 1. Wikipedia.pl, Luke33,
Illustartion 2. Wikipedia.pl, AugPi

Spiral – a flat curve that circles repeatedly around a point and moves away from that point.

Archimedes' spiral



Fibonacci spiral

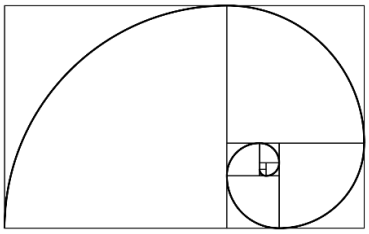


Illustration 1. Wikipedia.pl, AdiJapan
Illustration 2. Wikipedia.pl, Dicklyon

Torus – a two-dimensional rotating surface resembling an inflatable bicycle inner tube, a swimming wheel, a donut or a bagel.

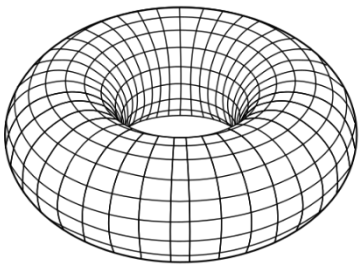


Illustration: Wikipedia.pl, Inkscape

Möbius ribbon – a one-sided surface that can be achieved by joining the ends of the tape when one of the ends is turned through an angle of 180^{O}.

Illustration: Wikipedia, Dawid Benbennick

Index of mathematical concepts and prominent mathematicians

MATHEMATICIAN'S SURNAME	ROUTE NUMBER AND OBJECT NUMBER
Archimedes	IV.33
Banach Stefan	I.11, VII.54, VII.57, VII.58
Bartel Kazimierz	VII.59
Dickstein Samuel	V.40, V.42
Euler Leonhard	IX.88
Fibonacci Leonardo	III.24, VII.61, VIII.77
Kepler Johannes	I.12
Kopernik Mikołaj	III.29, IV.33, V.47, XI.100, XI.103, XI.104
Kuratowski Kazimierz	V.40
Łomnicki Antoni	VII.59
Mandelbrot Benoit	V.40, VII.60
Mazurkiewicz Stefan	V.40, V.42
Nikodym Otton	VII.58
Orlicz Władysław	I.1, VII.54
Pitagoras	III.25, V.36
Rejewski Marian	I.2, V.42, V.48, IX.89, XI.99
Różycki Jerzy	I.2, V.38, V.48, IX.89
Ruziewicz Stanisław	VII.59
Sierpiński Wacław	V.40, V.42
Sokrates	IX.82
Steinhaus Hugo	VII.54, VII.58, VII.65, IX.85
Stożek Włodzimierz	VII.59
Zygalski Henryk	I.2, V.48, IX.89

Ending

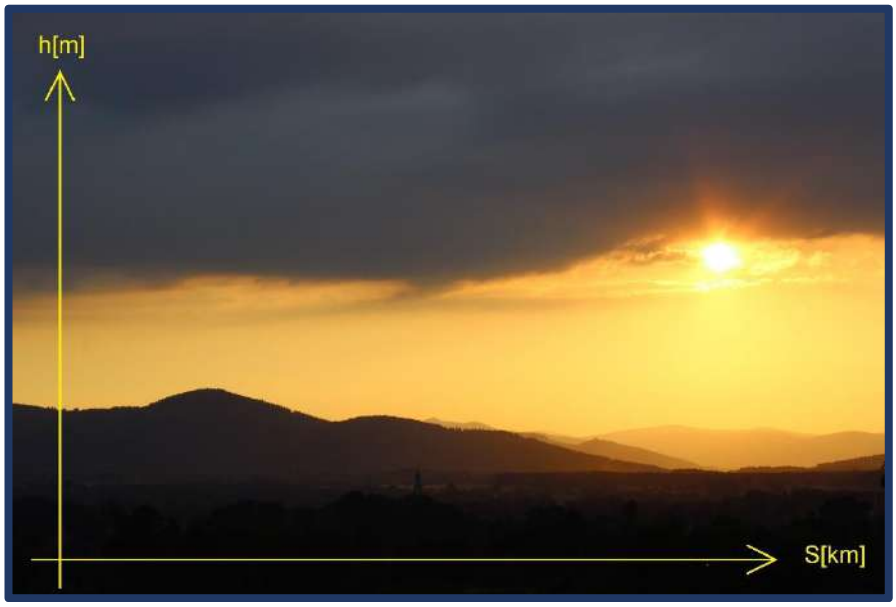
And that's how ours journey ends. We are very gratefull that we were able to make a trip to places, where math left hers remarkable beauty. Hopefully we managed to show that Queen Of Science can be interesting and useful, that it can be delightfull and inspiring.
We are aware, that there is lots more to find. And that's task for you. Some places, packed with geometric and numerical references, unfortunately are no longer there (like „Nieskończony zielony” or Restauracja Steinhaus). We hope there are many more, waiting for yours uncover.
Math is ubiquitous, irreplaceable and although hard to understand at times, it will always be important part of our lives. However we should look for it in our everyday life, try to feel it, play with it.
Presented memorials of Polish Great Mathematicians should be symbol and appeal for peace beyond all differences and borders.
Maybe they will become an encouragement to explore compelling but challenging world of mathematics.

Please contact us to share yours discovers of math related places in our country.
mc.przewodnik@gmail.com
mkk.przewodnik@gmail.com

Kind regards! See you soon on our math trail! :o)

Magdalena Ciesielska (on the left)
i Maria Kaliszan-Kaźmierczak (on the right)

Wykres Tatrzańskich szczytów



Photos: Magdalena Ciesielska, private collections

"To be in love with math is like being crazy with the right mind."

Kazimierz Skurzyński (remake of Ovid)

Bieszczady angles

Tangent on the Baltic Sea?

Forest parabola

Photo: Magdalena Ciesielska, private collections

POST SCRITPUM

After the guide was already finished we were able to find two more places.

- **"Pikawa Caffe"** in Gdańsk at Piwna 14/15 where, with great cup of caffe, you can discus famous Ludolfine, well known to all high schollers π. This greek letter adorns their stylish bar.
- **"Hugonek"** - another mathematical gnome lives in the Osiedle Popowice at Jelenia 7 in Wrocław. It is lucky charm for students of 5th Primary School in Wrocław, because it's named after school patron Hugon Dionizy Steinhaus.

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